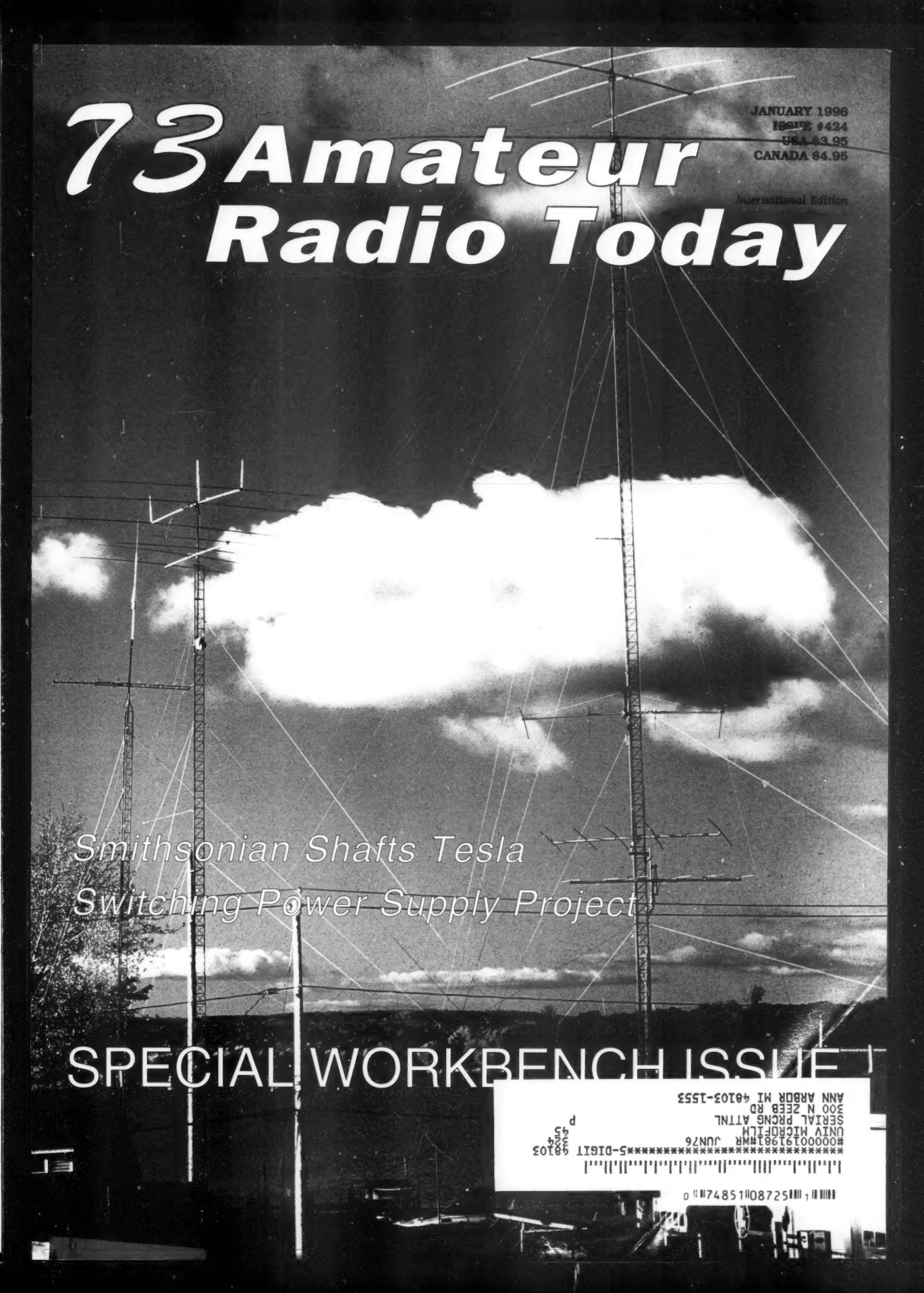
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JANUARY 1996
ISSUE #424
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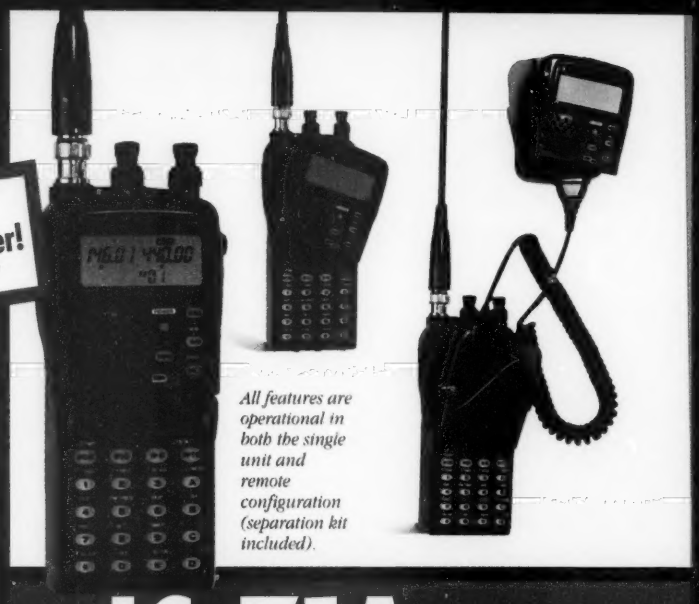

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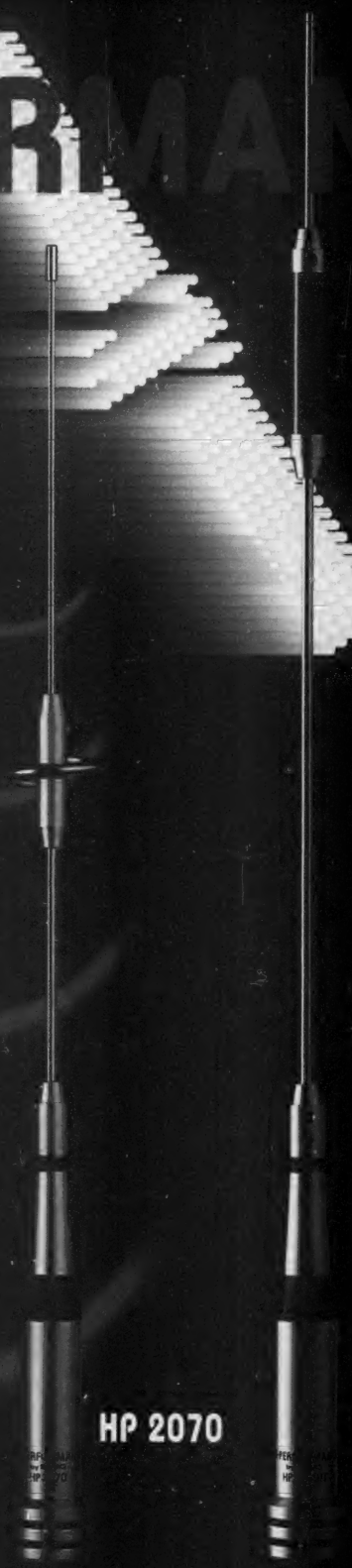

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JANUARY 1996
ISSUE #424

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On the cover: The photo shows the QTH of Dick Sparling N2KEY on Chautauqua Lake, Bemus Point, NY.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is the page number on which the article or column starts as shown in the index.

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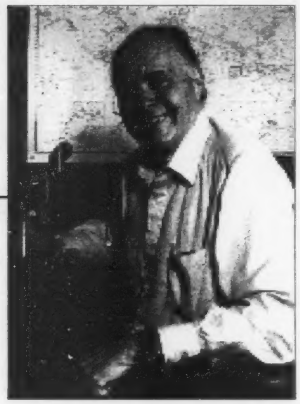
NEVER SAY DIE

Wayne Green W2NSD/1



Sunny Surprise

Astronomers at the California Institute of Technology have reported the first sunspot of the new cycle. Pause a moment for a round of cheers. They were surprised at the early start for Cycle 23. It's expected to peak around 1998, since the spots tend to build up rapidly and then fade away more slowly.

It'll be nice to have the HF bands open around the world again, and to be able to make contacts all night on 20m. During the better sunspot peaks even 6m opens up, allowing worldwide communications with low power. I remember one day when I tuned 6m with my pre-war Meissner FM tuner and heard the sixes and sevens boiling through. That sent me right to my workbench to build a 6m transmitter. Well, to convert a surplus SCR-522 rig to six.

Maybe you didn't know that the pre-war FM broadcast band went from 50-56 MHz, with us hams on five meters, 56-60 MHz. The two-and-a-half meter ham band went from 112-116 MHz. Well, mc, actually, since hertz hadn't been invented yet as a replacement for cycles per second. The SD radar on my submarine was on 112 mc, so I felt right at home. The main problem with that was that the Japanese quickly installed 112-MHz receivers in their planes so they could home in on our radar. That tended to discourage us from using it other than for an occasional quick blast.

The SJ radar, which was mainly for surface work, was up at 3,000 MHz, where the Japanese apparently hadn't figured out how to build receivers. So I used the SJ for spotting both ships and planes, and kept the SD off most of the time.

Back in 1949, I was one of the six meter pioneers. I was the only one on six in New York City. We were all crystal-controlled in those days, so I could tell the call letters of any signal, just by measuring its frequency with my surplus General Radio LR-1 frequency meter. Big sucker, with nearly a hundred tubes.

I got a 50.1-MHz crystal and set up a beacon so hams out West or in Europe would know when the band was open to my area. I made a code wheel out of aluminum, operating a microswitch to key the rig.

As the new sunspot cycle builds we're going to see DX coming back, so it's time to start planning your dream location, dream tower, dream beam and state-of-the-art ham station for late 1996. I've got the location, but I need some help in deciding what I should use for antennas.

In retrospect I can almost feel the angel wings brushing me when I tuned 6m and heard the pandemonium from out West. That got me on the air on six. And that got me to put on my beacon station. Then, along came Perry Ferrell with an Air Force contract to study 50-MHz propagation, so I helped him with my reception reports, plus the reception reports of my beacon. This was the Radio Amateur Scientific Observation project, RASO.

Perry awarded me a certificate for helping the project. Then, a couple years later, he became the editor of *CQ*. By then I was deep into RTTY. Perry liked my *Amateur Radio Frontiers* magazine and asked me to do a RTTY column for *CQ*. That helped generate more interest in RTTY, but more important, I got to be good friends with Perry, and knew he hated *CQ* publisher Sandy Cowan. So I helped Perry get the editor's job at *Popular Electronics*, since I knew the publishers, Bill Stocklin and Ollie Read. That led to me becoming the *CQ* editor, which I hadn't even considered before. Serendipity.

Adopt-A-Ham

I was reading in the Dayton club newsletter about the program set up by the Upper Valley Radio Club with Beavercreek's Brookwood Elementary School. They lined up four 9- and 10-year-old students to talk over the local repeater to each of seven club members. The aim wasn't primarily to get them interested in hamming, but rather to help the kids develop their ability to talk with people. That's called oral skills these days. However, two of the kids did get their tickets, and many previously inarticulate kids learned to talk freely with total strangers over the air.

Antenna Pruning

An article by W3HVS in the Port St. Lucie club newsletter reminded me that it's been years since I passed along a simple antenna pruning system. You can cut a half-wave dipole wire antenna exactly to the frequency you want with just one prune, if you do it right.

You start out with the half-wave formula of 468 divided by the frequency in MHz for the length in feet. Add on a foot or so, just in case. It's a lot easier to trim off a few inches than to add it if you come up short. The problem is that the length of your antenna depends to some degree on its height above ground, and how good the ground is under it.

Make it a little long and put it up into place. Now check for its resonant frequency. An antenna bridge is great here, but you can also just check for the frequency providing the lowest SWR. Now you can use a simple proportion of the length and the resulting resonant frequency to the desired frequency and the new length. Trim half of the difference off each end and you'll be all set.

You won't do a lot on 20m with a dipole, though my first sideband contact was with a 10-watt exciter and a twin-lead dipole thrown out of my window. I worked a VK and had a nice contact.

On 75m I've worked the world with a dipole. Everywhere. At the time I had a corking signal on 20m, but with the Sweepstakes Contest coming up the next day I knew I would have to have some 75m contacts during the hours when 20 was quiet, so I cut a twin-lead dipole and hung it slanted from my tower. The result was a whopping signal on 75, and contacts all the way out to Okinawa.

When I was visiting VK3ATN in Australia we worked W2NSD/1 on 20m. My signal was coming in S9+, so we decided to try 75 and see if we could make it. It was S9+ there too! I still haven't gotten over the excitement of that contact. Never will.

Pirate FM

Recently I wrote about a possible business opportunity for hams in setting up low-powered FM transmitters for private parties who'd like to be able to listen to their own music around their home. A chap in Berkeley has been carrying this to extremes with his Free Radio Berkeley (FRB). Steve Dunifer started out with a 5-watt rig and a 10-foot antenna, broadcasting three hours Sunday nights on an unused FM channel. The FCC naturally got after him, assessing him a $20,000 fine. Dunifer fought back with lawyers, demanding to get copies of the reports of interference, which the FCC had cited in their complaint.

When the FCC could produce nothing, Dunifer began making and selling micro-power FM transmitting kits, with the result that several hundred similar stations are now in operation around the country. Then, when a federal judge refused to back the FCC on constitutional grounds, he took FRB full-time from a permanent location, broadcasting 24 hours a day, complete with a call-in phone number and running about 40 watts.

Canada allows unlicensed micro-power FM stations, but monitors them to make sure they don't interfere with commercial stations. And in Japan unlicensed FM stations with up to 10 watts are permitted, with community stations popping up all over the country. Companies such as Teac and Sony are selling micro-power FM station kits which include everything needed, even a CD player.

Brazilian Licenses

A note from PU2MPP explains that they have three license classes in Brazil. Class C requires no code. Class B requires 5 wpm code. Class A is 10 wpm. To be more detailed, the Class B test sends 125 characters in five minutes and calls for a minimum of 87 characters to be copied correctly. The Class A is double that. That sure beats our 20 wpm hurdle.

If You're So Smart...

Okay, as a ham you are a communications expert. Well, you're supposed to be. That's what you've conned your non-ham friends into thinking, right?

So what do you really know about communications, other than kerchunking some repeaters or adding still more garble to a pileup? If someone were to ask you about pagers, what could you tell them? How much do they cost? What's their range? Where do you get 'em? What frequencies do they use? What services are available? Can you use some just around your own business?

And what can you tell people about fax-modems? The Internet,

Continued on page 74

J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little handheld 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

The Pico Solution

Today, the travelin' man has a ready solution to the problem: a neat antenna produced by Antennas West and called the "Pico-J." It meets all the requirements set forth in the first sentence. Pico means "small," as in "picofarad," and "J" stands for "J-pole," the well-known low-angle, omnidirectional vertically polarized antenna—just what's needed for 2 meters.

Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

Best of all, considering the benefits, is the price: $19.95 for the 2 meter model, $26 for the 2m/70cm dual bander, both complete with the soft vinyl case to store your Pico-J when it's not in use.

On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

*–condensed from **RadioFun***

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LETTERS

From the Ham Shack

Dick Smith W4KHV Over the years I have enjoyed your columns and find them not only enlightening but thought-provoking. While I have not always agreed with all you have said (does anyone always agree with everything one says?), I do find myself siding with your thoughts most of the time. Superfluous for me to say, keep it up, as I know you will. Thanks. After reading your November editorial I would like to comment on a number of subjects you touched on. First, you asked for letters about most recent building projects, etc. Well, I do build small electronic projects now and then for my other main hobby, RC model planes. I have been in model planes since I was a kid and RC planes since 1949. I have been a licensed ham since 1953 (W1ZVG). However, I do not build much ham equipment now, other than a QRP rig this past year. My antenna will have to be improved before it's a real success. I still build quite a few planes, with my largest being a 9' (wing span) replica of a WWI Sopwith "Pup" biplane. This is an RC plane which is 1/3 scale. I fly on both 6 meters and 72 MHz. Radio "contests" do not move me, nor do nets. About 80% of my hamming is on 40 CW, and I enjoy it. Yes, I know CW is dead to many, antique, etc., and not promoted by people such as youself. But still, it's fun—isn't this what this hobby should be? And yes, the other side of the coin is to develop new ideas, techniques, invent, and pioneer. This where your insight is so valuable to those technically capable. I also participate on a local level in various community projects, including ARES and Skywarn. Your November column was one of your better info columns. In fact, I asked my wife to read it from start to finish (she did). It was the first time she has ever read anything from a "ham" magazine. She was really taken by your observations about the Government cover-ups, roadblocks to cures, health, etc. I'm sure she'll be reading your future colums too. We tried your old recipe for coleslaw. It was very good and we'll be using it again, but with a little less vinegar. Then we'll have a good comparison to make against our favorite recipe. Thanks for giving it out. We both try for low fat foods (and high fiber) so will be giving it try with the low/non- fat ingredients.

Although not a ham as long as you Wayne (I'm 65), I have had a number of honors as result a of being a ham. My highest one was when I lived in the Phoenix area back in late '60s and became one of Barry Goldwater's MARS operators. I ran phone patches from his home to servicemen in the Pacific and Southeast Asia. To this day I don't believe the public, or hams, really know what a contribution he made to the morale of our servicemen in those areas. When I was out there he had two complete stations, one was Collins equipment capable of running 4kW, and one with Drake equipment running 2kW. Aside from spending some long evenings after a day's work, it was fun and most satisfying from a personal standpoint. It's still a great memory.

You can adjust the sourness of the coleslaw dressing by adding more sugar or honey. It's also a fabulous dip for raw veggies. Cheaper than the bottled dressing, too . . . Wayne

Michael D. Zandee AA8QL Gee whiz Wayne, we better keep the code requirement and six license classes, or we won't have anything at all to discuss on the air. Here's my two cents on Mr. Weinhold N3EUL's letter. I'm sure you *can* tell the new no-coders, but not for long. They either conform or the old heads run them off. Then Mr. Goodman W3UWH's call for a senior upgrade: If they want it bad enough they would find a way. It's too bad your friends won't even try. I went from no ticket at all to Extra in four months and found it felt like cheating. It was so easy I didn't get the sense of accomplishment that should have been there.

Richard Heppert KC4YQL In the October issue there was an interesting article by a ham who had finally pushed himself to get his Extra after 46 years. He was now finding it rewarding to work testing sessions and Elmer others through the upgrade process. Bravo! But he was also finding too many of his fellow longtime operators were reluctant to attempt to upgrade because, although they could handle the code speed, they felt they could not learn the necessary math. He proposed creating a special upgrade license for these old-timers as a reward for their many years of "service," and requested feedback on the idea. I had to check to be sure that it wasn't the April issue. This past weekend I participated in a discussion at a local hamfest that worked its way around to the code requirement. It was the opinion of one fellow (my guess is he was 50ish) that he would rather see the FCC drop written tests altogether than see an elimination of the higher speed code requirements—after all, "nobody builds or repairs anything anymore so the tests are irrelevant." The "logic" of the two proposals eludes me—or just maybe I see it too well: Screw any relevant technical knowledge, theory, and regulations, and give higher licenses to those who have nothing better to do than practice the oldest form of communication known to hams—CW. As for the first proposal, the satisfaction of having performed service, had it actually been performed, should have been its own reward. Had these old-timers grown and progressed with the hobby's technology they would have had little trouble passing the technical tests, or at least been less scared to try. As for the proposal to eliminate written tests about regulations, procedure, propagation, antenna theory, safety, band plans, and modes, not to mention basic electronic theory, but keeping CW, this is a blatant cry for elitist "I did it—they should too" mentality. If CW is so important, I'd like to propose re-testing every five years on written and code. If you don't pass you're busted back to Novice and have to work your way back up. Do we see a few quaking in their boots at that thought? Seriously, the FCC tests for each license class should change/grow with the technical advancement of the amateur radio "service," and for a large part they have. The major exception has been the Elements 1B and 1C CW requirements (1A is still necessary to meet ITU regulations). The only way we are going to keep our bands is to recruit, encourage and reward the innovators, not reward hams for merely existing and not causing trouble. Extra privileges and band space should go to the people willing to use and explore newer technologies; after all, from the beginning that is the major reason we were allocated our bands. If any testing changes are made they should start with the elimination of the 1B and 1C elements, with further emphasis placed on today's and tomorrow's technologies, not yesterday's. Grow, or die.

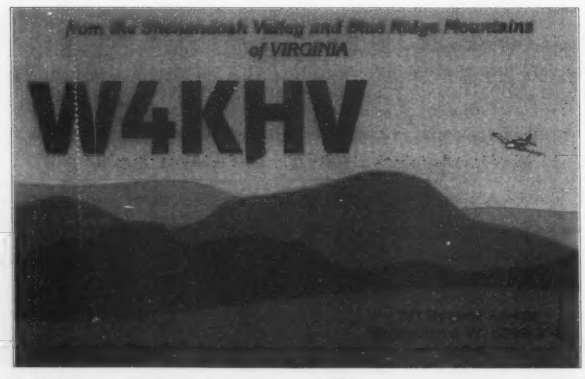
When hundreds of ham clubs, under pressure from the ARRL, wrote to the FCC claiming that the Morse code was of enormous importance for its potential use in emergencies, I said, if you honestly believe what you testified to the FCC, then we obviously should require code tests for every license renewal. Oh, the frenzied screams of anguish that raised.

No, no, they meant that newcomers should learn the code . . . Wayne

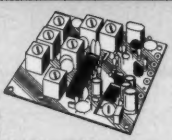
Richard A. Medhurst KD6BFO. In response to the letter from Terry Weinhold N3EUL, as published in the October 1995 issue, I must say that the facts do not support his conclusion that the code requirement makes for a "higher-quality operator." A review of the "Happenings" column in *QST* for the calendar year of 1993 would tend to disprove this conclusion. The facts are that during 1993 14 licensed amateurs had monetary action or revocation of license by the FCC. One Tech (7.15%), five General (35.7%), two Advanced (14.3%) and six Extra (42.85%). As you can see, 92.85% have 13-word or better licenses. During a recent public service event in San Diego, a two-by-two call maliciously and willfully interfered with communications. That's a "higher-quality" operator? If the 2 meter band sounds like CB in Mr. Weinhold's area then there is no one to blame other than the pre-no-code amateurs. It was up to them to educate the new licensees as to proper repeater protocol. If they do not know the rules, how can you condemn them? To infer that the only "good" operators are those with code is exactly the type of narrow-minded attitude that keeps the young people out of amateur radio. I do not advocate the elimination of CW, only the easing of the 13-word requirement. I also advocate more stringent technical testing for HF privileges. I may be a lowly Tech, but I have many friends who are General, Advanced and Extra Class who come to me for technical assistance.

Jan Hair N5LVI After reading the letter on Senior Citizens Upgrade, I thought I'd write a response. Maybe who is regarded as a "Senior" is relative to a person's age. I first acquired a General Class license in 1956. Following that year, we added to the family until we had five harmonics. Busyness with family and no antenna shut me down for 17 years after the expiration of

Continued on page 87



WWV RECEIVER



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FEATURES:

- **Very low noise:** 0.7dB nf vhf, 0.8dB uhf
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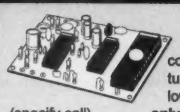
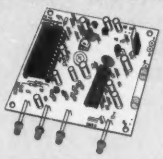
REPEATER CONTROLLERS



NEW **CWID-2.** Eprom-controlled, miniature, easy to build, low power CMOS, (specify call) ..... **only $54 kit, $79 w/t**



COR-6. COR & Real Voice ID on one board. Digital ic records up to 20 seconds of your voice. Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter. .....**kit $99, w&t $149**

COR-3. COR, timers, court.beep .... **kit $49**
CWID. Diode programmable ..... **kit $59**

COR-4. Complete COR and CWID all on one board. CMOS logic for low power consumption. EPROM programmed; (specify call) .....**kit $99, w&t $149**

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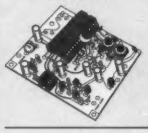
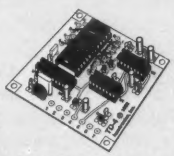
DVR-1 DIGITAL VOICE RECORDER. Records up to 20 sec. of your voice with built-in mic. or external mic. Terrific as voice ID'er for repeaters or fox hunt xmtr, contest caller, radio notepad, etc. Extensive manual tells how to use multiple messages adapt to many applications. .....**kit $59, w&t $99**



TD-4 SELECTIVE CALLING MODULE. Versatile dtmf controller with 1 latching output. **Mutes speaker until someone calls** by sending your 4-digit tt code. Or use it with a **long tt zero** digit to alert anyone in club for emergencies. Also may be used to **control autopatch or other device**, like TD-2 except only one output. .....**kit $49, w&t $79**



TD-3 CTCSS DECODER/ENCODER. Prevents access to repeater or receiver unless proper tone is present. Tone output for transmitters, too. ..... **kit $29, w/t $59**

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AP-3 REPEATER AUTOPATCH. Reverse patch and phone line remote control. .....**kit $89, wired & tested $139**

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MO-202 FSK DATA MODULATOR & DE-202 DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver.....**kits $49, w&t $79**

9600 BAUD DIGITAL RF LINKS. Call for info on low-cost packet networking system: MO-96 Modem and special versions of our 144, 220, or 450 MHz fm xmtrs and rcvrs. Use directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

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REP-200 REPEATER

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50 & 900 MHz bands slightly higher

- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- **FCC type accepted** for commercial service in150 & 450 bands. *(Request catalog for details.)*

REP-200T Voice Message Repeater. As above, except includes Digital Voice Recorder. Allows message up to 20 sec. to be **remotely recorded off the air.** Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!**.....**adds only $100!**

REP-200C Economy Repeater. Uses COR-6 Controller (no DTMF control or autopatch). Features **real-voice ID.** .....**Kit only $795, w&t $1195**

REP-200N Repeater. Want to use your own controller? No problem! We'll make you a repeater with rf modules only. ..... **Kit only $695, w&t $995**

XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

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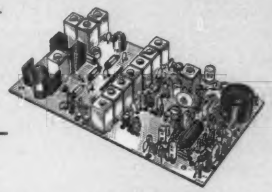
FM EXCITERS: 2W continuous duty.
FCC type accepted for com'l bands.



- **TA51**: 50-54, 143-174, or 213-233MHz.
- **TA451**: 420-475 MHz . *New low price!*

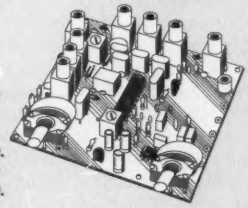
Either model: .....**kit $99, w/t $169.**

- **TA901**: 902-928 MHz, (0.5W out);

New low price! ..... **w/t $199.**

VHF & UHF AMPLIFIERS.
For fm, ssb, atv. Output levels from 10W to 100W. Models **starting at $99.**

FM RECEIVERS:



NEW **R100 FM RECEIVERS** for 46-54, 72-76, 140-175, or 216-225 MHz. **Very sensitive** – 0.15uV, **exceptional selectivity** – both crystal & ceramic if filters for >100dB at ±12kHz (best available anywhere), **flutter-proof** squelch. .....*New low price!* **kit $129, w/t $189.**

- **R451 FM RCVR,** for 420-475 MHz. Similar to above. *New low price!* **kit $129, w/t $189.**
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NEW R150 MONITOR RCVR for 143-164 or 216-225 MHz. 4-channels. Great for monitoring repeaters, amateur calling frequencies, packet radio, commercial two-way radio, police/fire frequencies, or weather forecasts. **Good starter kit,** easy to assemble and align..... **kit only $99, w/t $189.**

- R120 AIRCRAFT RCVR for 110-136 MHz..... **kit only $99, w/t $219.**

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Join the growing ranks of amateurs who get striking images directly from the weather satellites! We used our 30+ years of experience in designing high-quality vhf receivers to bring you a new enhanced version of our long-popular WeSat receivers. The new R139 is a very sensitive wideband fm receiver optimized for amateur reception of NOAA APT and Russian Meteor weather facsimile images on the 137 MHz band. Use with any popular demodulator and software. Covers all five popular satellite channels. Scanner circuit and recorder control allow you to automatically search for and tape signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit less case** **$159**
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- **R139 Receiver Wired/tested in case with 12Vdc power adapter** **$239**

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QRX . . .

Private Ham Satellite

Bob Bruninga WB4APR may become the first ham with his own amateur radio satellite in space. The Glen Burnie, Maryland, ham hopes to have the new amateur radio satellite in orbit by next summer.

No, this is not a joke or a pipe dream. Bruninga is the director of the Satellite Education Laboratory at the Naval Academy in Annapolis and the satellite is a departmental project. Its primary aim is to provide every school in the country with packet radio satellite access:

"We try to participate in all the SAREX missions with our students. The only problem is probably only 1% of the orbital passes is operational in the packet mode on the SAREX and you never know in advance. It is very hard for the students to go to all this effort and not be able to make a packet link to the spacecraft. So, we think that there ought to be a very low budget, low tech packet satellite up there that is always on, always operational. And every time it comes over any high school in the country the students will see something."—Bruninga

Bruninga says he plans to fly a one-watt Picosat transponder operating on 2 meter FM packet at 1,200 baud. The system is specifically designed for digipeating position reports.

"Once you get the satellite up there then we can track guys driving across the country in their recreational vehicles, we can track guys in their boats out in the bay and up and down the Atlantic...all over the world really. That's why we think there is tremendous potential for position reporting.

"I mean that's what amateur radio is. It's not sitting in your basement. As far as our ability to contribute to the state of the art and to public service, our abilities are not sitting in out basements. Our abilities are mobile."—Bruninga

Bruninga says that he already has a tentative invitation from NASA for a free launch on an experimental booster. The earliest possible launch date is in May. But WB4APR says that the date could easily slip. A lot depends on when the satellite is ready to fly. The parts are within arms reach, says Bruninga, but construction has yet to begin. *TNX Amateur Radio Newsline*

Dove S-band Is On

Still with ham radio satellite news, Jim White WDØE reports that the DOVE DO-17 ham satellite S-band transmitter is on. Jim says that a recent software load allows better power control and controllers now expect to be able to keep the pesky transmitter in operation on 2,401.220 MHz. *TNX Amateur Radio Newsline*

RF Lights

RF light bulbs are on their way and they could add to the QRN currently on the ham bands. This, after the Federal Communications Commission waives its rules to permit the General Electric Company to begin marketing a new RF-powered light bulb.

At GE's request, Part 18 of the commissions regulations has been waived. Part 18 limits on the amount of RF energy that can be conducted into the electric power lines by RF lighting devices in the band 2.2 to 2.8 MHz. GE proposes marketing to consumers an unlimited number of RF light bulbs that comply with the conduction limits for nonconsumer RF lighting devices in this band.

Commission rules already permit RF lighting devices used in commercial environments to place this signal level on the AC power lines. The FCC says that there has been no record of significant interference problems from the use of these devices in commercial environments. It also says that radio operations in the range 2.2 to 2.8 MHz are not normally employed or intended for reception in residential environment. GE was granted a waiver for one year, and the FCC reserved the right to revoke the permit if it determines that RF lighting devices operating under the conditions of the waiver create severe interference problems.

Three years ago, a California company, Intersource Technologies, promoted an RF-powered light bulb that operated at 13.56 MHz. According to the manufacturer it was designed to keep unintentional radiation to a minimum. The company claimed that its 25-watt RF bulb could generate as much visible light as a 100-watt conventional bulb but these lamps were never marketed.

And the ARRL says it has a definite interest in what kind of interference the GE RF bulb may generate. The League says that it will obtain samples of the GE bulbs for testing as soon as they are available. ARRL Laboratory Supervisor Ed Hare KA1CV says that the new bulbs should not, if properly designed, create any more interference to Amateur Radio operations than fluorescent bulbs, dimmer switches, or other similar devices found in the home. Other experts disagree. They point to the problems that a bad incandescent lamp dimmer can create for the average ham. *TNX Amateur Radio Newsline*

Airwave Auction

The Supreme Court has given the Federal Communications Commission approval to go ahead with its planned December 11th auction of 498 licenses for small businesses. A company called Radiofone Inc. had challenged the commission's cellular personal communications services cross-ownership rule, which limits cellular companies to 40 megahertz of spectrum in their cellular service areas.

But in vacating a stay issued by a Federal Appeals Court, Justice Stevens noted that allowing the national auction to go forward would not prevent the federal appeals court from granting Radiofone appropriate relief if it later found that the company's case has merit. As a result, the multimillion dollar auction will proceed. *TNX Amateur Radio Newsline*

1996 VE Test Fee

The cost of getting a ham radio license is going up again in 1996. Effective January 1st, the maximum allowable reimbursement fee for an amateur operator license examination will be $6.07. The FCC set this amount based on the Consumer Price Index between September 1994 and September 1995. It's an increase of 17 cents from the current $5.90 fee.

Actually, nobody really makes any profit from ham radio testing fees. Volunteer examiners and volunteer examiner coordinators are permitted to charge examinees for out-of-pocket expenses incurred in preparing, processing, administering, or coordinating reexaminations for amateur operator licenses. The amount of any such reimbursement fee from any one examinee for any one examination session, regardless of the number of elements administered, must not exceed the maximum allowable fee. *TNX Amateur Radio Newsline*

FCC Wireless Chief Moves

Regina Keeney, chief of the FCC's Wireless Telecommunications Bureau, which oversees Amateur Radio, has been promoted to chief of the Commissions Common Carrier Bureau. Keeney, who has been chief of the WTB since the bureau was formed last December, replaces Kathleen Wallman at Common Carrier.

Regina Keeney is the daughter of John Markey W2AAW and Marge Markey N4XZD. When she was named as chief of the Wireless Telecommunications Bureau she is quoted as saying that she had grown up in an enthusiastic ham radio family.

The FCC, in announcing Keeney's move over to Common Carrier, said that during her tenure at the WTB, she oversaw the commission's auctions of electromagnetic spectrum and worked to develop fair rules of competition in the wireless communications marketplace. Thanks to her leadership, says the FCC, the previous backlog in license application processing has been cut in half.

No successor to Keeney in the Wireless Telecommunications Bureau has yet been announced. *TNX Amateur Radio Newsline*

Paralyzed Assistance Needed

Bill Farley WA5FLG has posted a packet message asking for help for a paralyzed ham. Bill says that Lowell Richardson W5UBW, an avid DX chaser, has become paralyzed but wants to be able to communicate.

Bill says that Lowell no longer can speak. Bill is looking for any device that would help his friend who has the use of one hand only.

If you have any ideas, send them by packet to WA5FLG@K5WPH or call Bill at (505) 437-5508. He is in Alamagordo, New Mexico, and is on Mountain Standard Time. *TNX Amateur Radio Newsline*

Canada Adopts IARP

On the international scene, Canada has announced that it has agreed to adhere to the Region 2 International Amateur Radio Permit. It's the fourth country to do so and has issued the first two permits. These went to Radio Amateurs Canada

Continued on page 87

The SP-10 "Senior Spider" Transceiver

Mike Agsten WA8TXT
405 W. Bogart Rd.
Sandusky OH 44870

You may have heard (or know firsthand) that transmitter power levels of 1 watt or less can indeed "get out" and have accounted for some remarkable feats of DX. It's true.

It's also true that 1 watt, in HF skywave service, has little endurance to spare. You get lucky and snag a good one when the band is optimum and two minutes later, you're talking to yourself because of QSB or QRM at the other end! Clearly, some extra holding power is called for if you want to chew the rag or make 5-WPM Novice QSOs that, of necessity, take longer to complete. The question is, how much will it take to do the job?

When it comes to transmitter power, the sky's the limit of course, up to the legal limit for your license class, but here we also want easy construction and minimal cost to encourage beginners so we'll just split the difference between a measly 1 watt and the widely effective 100 watt levels. And the answer is...10 watts! That's right. To judge the effect of a power change, you must think in terms of dB (decibels) and not be mislead by the watts. Ten watts is 10 dB better than 1 watt and 10 dB worse than one hundred, placing it on middle ground theoretically and in terms of on-the-air readability.

The rig to follow is a simple 10-watt, crystal-controlled CW transceiver that may be built for 80, 40, or 30 Meters. You can build it and learn a little about how it works. Should it ever malfunction, just fix it yourself. There's no need to rely on the service of a distant repair facility. That's independence!

The SP-10

The SP-10 presented here is functionally very similar to its predecessor, the SP-1 (Jan. 1993 issue of *73*) which has enjoyed popularity in the QRP world. The receiver front end is triple-tuned to improve in-band sensitivity and out-of-band rejection. The dual-gate MOSFET receive mixer has been retired and its job turned over to a multifunction IC that also includes an op amp for audio bandpass filtering and a very effective audio muting switch. A low-noise audio preamp stage for increased gain rounds out the receiver improvements.

The transmitter section is pretty much the same as the original "Spider" except here it drives a power MOSFET "afterburner" producing 8 to 12 watts of RF output. Physically, the highly successful SP-1 layout has been retained wherever possible. The additional circuitry requires a larger circuit board which fits comfortably in the next size up enclosure, an RS #270-232 measuring about 8" w by 4" d by 2" h.

"Your brain needs a change of pace and here you get it whenever you close the key!"

The net effect of these changes is a quantum leap in overall transceiver performance and just a modest increase in cost and complexity. By strictly avoiding "dinosaur" and one-of-a-kind components in the design, easy duplication and maintenance for years to come is almost assured. So get with it and, next time, you'll be the one to say "Rig here is home-brew!"

Circuit Description

The heart of this radiotelegraph transceiver is continuous wave oscillator Q1 (refer to the schematic, Fig. 1). You plug a quartz crystal (more on crystals later) for the desired operating frequency into the top panel socket and Q1 circuitry provides the needed gain and feedback to sustain crystal vibration and supply

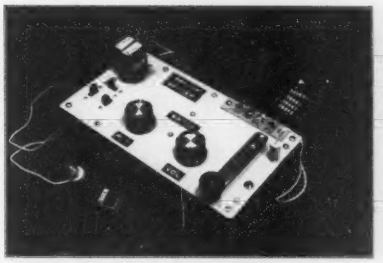

Photo A. *Top view of the SP-10.*

RF drive to other circuits via the secondary link on T1.

During receive, incoming signals pass through L5, L4, L3 and series resonant C23/L6 to receiver input circuits T2/C32 and T3/C33 (which are top coupled by C34) and onward to the receive mixer at U3 pin 18. There, in conjunction with oscillator signal via C18 to U3 pin 1, they are converted directly to audio at U3-3, filtered by C59 to remove unwanted RF byproducts and then audio bandpass filtered by the op amp at U3-12 and U3-13, which provides a distinct peak at about 400 Hz. In receive, the audio muting transistor at U3-16 is off (open) allowing signal passage to AF preamp Q6, volume control R47 and AF power amplifier U1 (pin 2 in, pin 5 out). U1 employs a small amount of negative feedback (C52) to roll off unnecessary high-frequency components in the AF output.

Receiver fine-tuning is accomplished by using RIT control R23 to vary the tuning voltage (via R1) to D1. This special tuning diode transforms RIT rotation into variable capacitance which, in conjunction with L1 and Y1, alters the oscillator frequency. Normally, this receiver is properly tuned when there is a 400-Hz difference between signal and oscillator. The resulting beat note provides peak output because it is centered in the audio bandpass response. Frequencies higher and lower receive less amplification. This is how selectivity is

provided; the desired signal is louder unless interference is overpowering.

Automatic receive-transmit switching (QSK) is initiated by closing the key. Q8 switches on, rapidly energizing the 12T bus which, in turn, accomplishes the changeover to transmit by switching several circuits. 12T via D8 mutes receive audio by placing a short circuit at U3-16. It turns on sidetone generator Q7 (a unijunction transistor or UJT) via R38 and R39. Sidetone allows you to monitor your telegraph sending quality by providing a nice, tight feedback loop that includes ear, brain, fist, and key. The sidetone in this rig also provides an important secondary function. Its complex, harmonic-rich output soothes your brain by dispersing all those headache-forming neural knots that may come from excessive sine wave exposure during receive. Your brain needs a change of pace and here you get it whenever you close the key!

Moving onward, 12T via R25 and Q5 grounds D1 tuning voltage to provide transmit offset which allows same-frequency transmit-receive with other stations. It switches Q3 on, enhancing oscillator output level via R5 and assisting transmit offset with C3. Finally, 12T keys Q4. which permits Q2 to amplify the incoming oscillator signal. Q2 output via low-pass filter L2 and resistive pad R14-17 then drives final RF power amplifier Q9 to full output of 8 to 12 watts, depending on band, power supply and transistor grade.

Harmonics present in this raw power are attenuated to insignificance by low-pass filter L3-L4-L5 and associated capacitors. Since the receiver input is tied directly to transmitter output at C23, D4-D7 are included to protect the receiver. Transmit RF turns them on and, while in conduction, they place a near-short at the junction of C23 and L6, breaking up the series resonance and forcing C23 and C22, because of their relatively low capacitance, to look like a high impedance during transmit, thus blocking most of the RF. This technique was actually developed for radar equipment where a sensitive receiver and high-power transmitter had to share a common waveguide. What you see here is the same principle in a less pure but still adequate form.

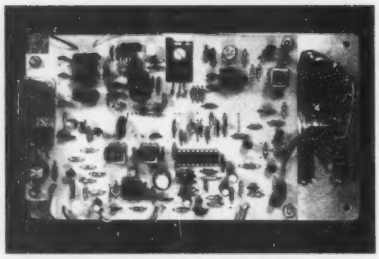

Photo B. Bottom view of the SP-10.

Construction

In the top view photograph of the SP-10, you can see the octal-type crystal socket in the left-rear corner. Since this socket holds two FT-243 or similar crystals, DPDT switch S2 is provided just in front to select one or the other. TB1, a four-lug terminal board, mounts along the rear edge of the top panel, near the right-rear corner. Its terminals are numbered 1 to 4 going from left to right. Connections to TB1 are DC power to 1 (+) and 2 (-) and antenna system to 3 (coax shield) and 4 (center). Along the right edge are 3.5-mm jacks for speaker/headphones (J2-rear) and external telegraph key (J1-front).

The built-in telegraph key is just left of the jacks. Its arm, a 3" strip of .025" thick brass or aluminum, is mounted on 1/4" spacers and grounded to the top panel by its two mounting screws. The key knob, a rubber or plastic equipment foot, is fitted or glued to the hex nut attached with machine screw, up through the arm. The head of this screw is the upper contact. The key contact beneath the arm is a 6-32 brass machine screw with head filed flat. This screw is insulated from the top panel with a shoulder washer above and fiber washer below, and secured with flat washer, solder lug (for connecting to) and hex nut.

The two knobs front and center on the top panel are Volume control R47 on the right and receiver incremental tuning (RIT) R23 on the left. Just left of RIT is slide switch S3, unused here but available for extra audio filtering (to improve selectivity) or other contingencies. Left of S3, in the left-front corner is DC-power control switch S1.

Running front to rear between RIT and Volume, and below the top panel, is a 1" wide by 3" long by 3/8" thick solid aluminum slab that provides heat sink and mounting platform for RF power amp Q9. This slab, to further increase heat dissipation, is attached directly to the aluminum top panel with three machine screws, heads visible in the photograph.

Most of the project is contained on the PC board depicted by the etching pattern in Fig. 2 and the parts overlay, Fig. 3. Of special note on PC board assembly, voltage regulator IC U2 needs 2 to 3 square inches of heat radiator coupled to its mounting flange. I cut and bent a piece of .025" aluminum sheet as shown in photo B (inside view) and on the parts overlay, and installed it between U2 and the PC board.

T4, the trifilar-wound matching transformer, uses two of the specified core placed side-by-side. The wire winding holds them together, no problem. Don't be intimidated by "trifilar winding." All you do is cut three equal length wires and twist them into a bundle. Thread the bundle onto the core until you have the specified turns count. It should look like an octopus with six tentacles coming off the bottom. Trim excess wire but allow enough for connections and installation. Now you have three wires on the core, arbitrarily designated A, B and C, and color-coded or tagged for easy identification. Connect the end of A to the beginning of B. Connect the end of B to the beginning of C. The beginning of A and the end of C remain single and go to "Com" and "Out" at T4 on the PC board. The two cross-connections go to "X" and "in." Voilà!

Because Q9 is the last part installed, even after the PC board is mounted to the top panel, provision must be made for connecting it to the top side of the board. I used short "flea clips" as mounting posts at holes G, D, and S. Anything snug enough to remain tight when reheated will do the trick here. In other words, you don't want the mounting posts to come loose from the PC board when you're attempting to solder the leads of Q9!

With the PC board complete, use it as a template to mark its corner mounting holes on the inside of the top panel as shown in Photo B. The heat sink slab mentioned earlier runs from beneath the rectangular Q9 cutout to the area between Volume and RIT. Drill and tap a 6-32 mounting hole for Q9's flange in the heatsink, positioned so Q9 leads will bend and reach the PCB mounting posts.

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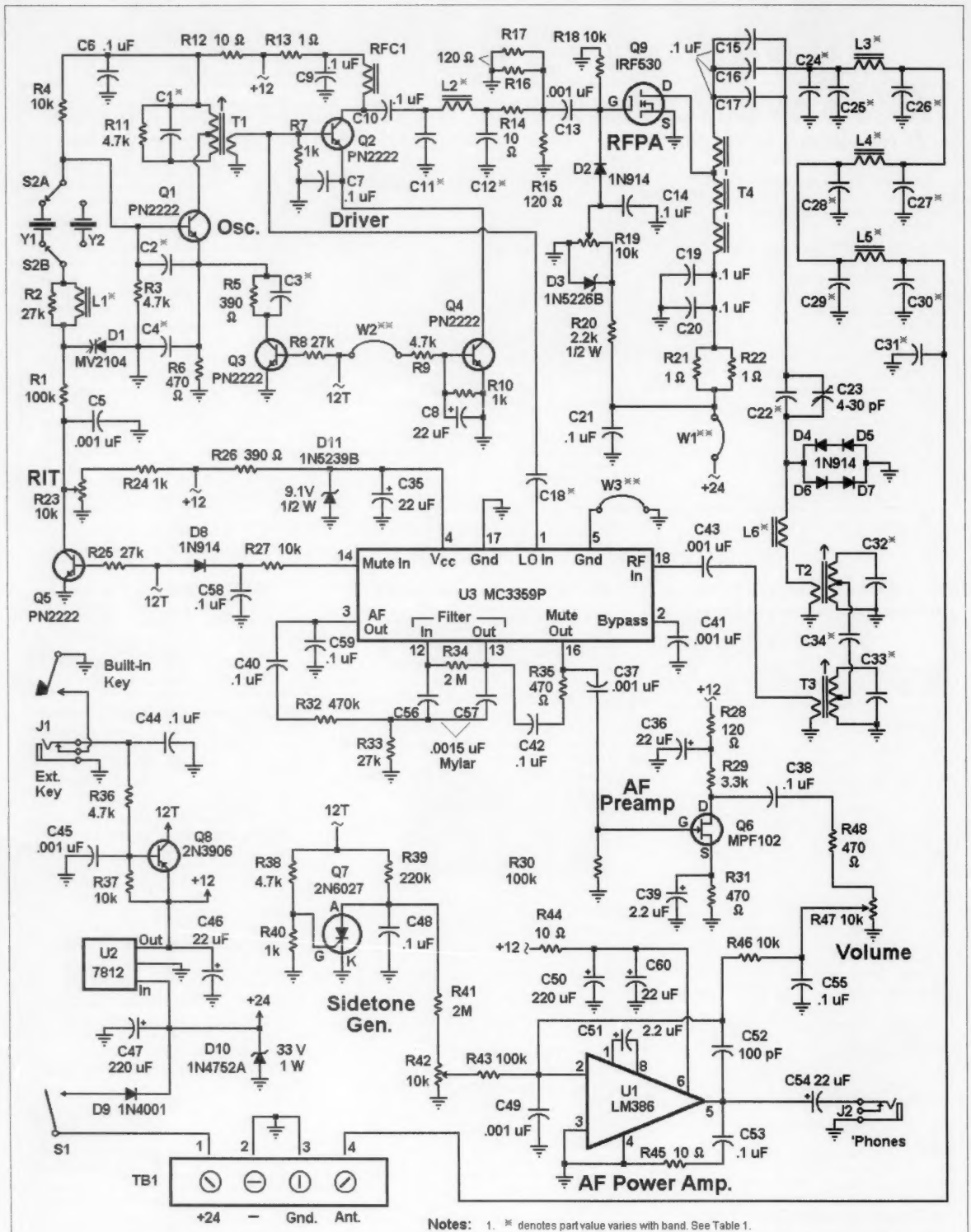

Notes:

1. * denotes part value varies with band. See Table 1.
2. ** W1-3 represent bare wire jumpers needed with the accompanying pcb layout.
3. Both Q9 and U2 require a heatsink. See text and photographs for details.
4. Component ratings: Unless specified, resistors are 1/4 W, electrolytic capacitors are 35 V and ceramic disk capacitors are 100 V.

Figure 1. Full schematic diagram of the SP-10 "Senior Spider."

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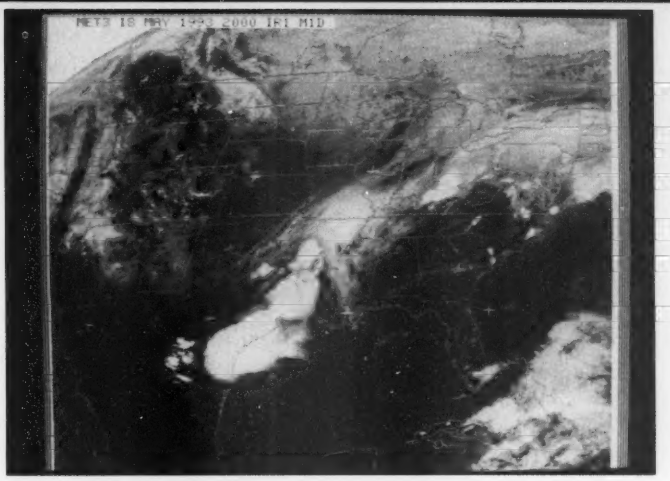

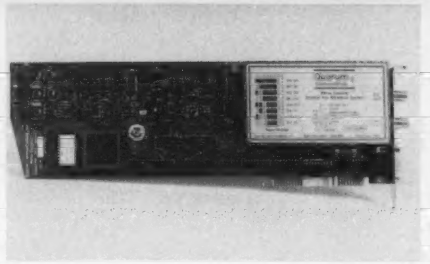

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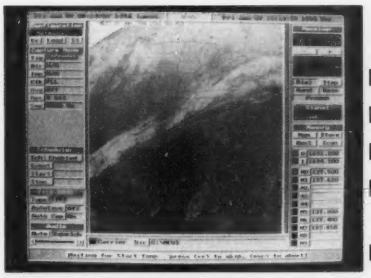

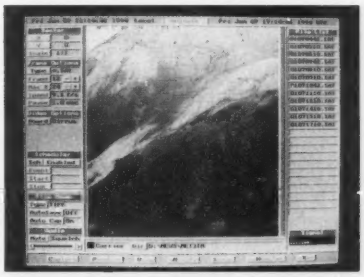

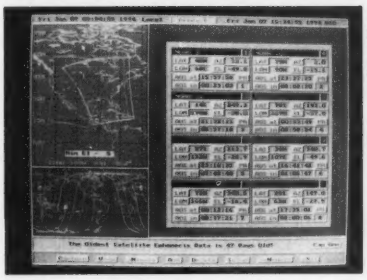

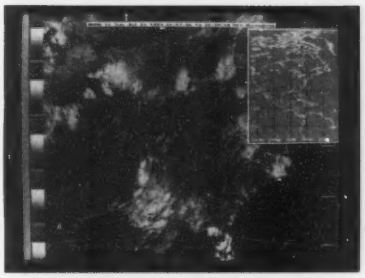

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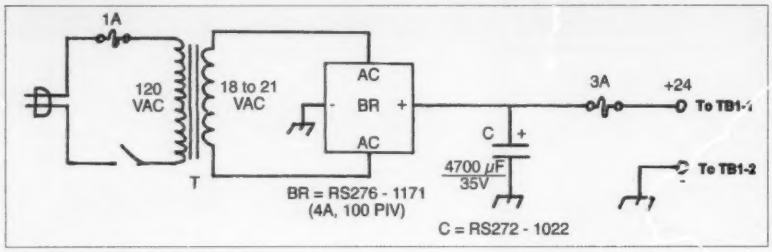

Fig. 4. SP-10 power supply.

Follow the photos to lay out and install the remaining top panel parts, the positioning of which is much less critical than the need to keep Q9 cool.

Except for the short ANT/GND and Y1 wires, connect the PC board to top panel components as shown on the schematic diagram or parts overlay. Hinge the board over and mount it to the top panel on 5/8" metal spacers, and then connect the short wires to TB1 and S2. Check to ensure the copper side of the PC board is not touching any panel components like potentiometers or jacks. Lastly, install Q9 to the heat sink using a heat conductive insulator pad and 6-32 Teflon or nylon screw or a TO-220 transistor mounting kit, to couple the flange thermally but not electrically to the heat sink slab.

Power Supply

A suitable power supply for the SP-10, one supplying 18 to 28 VDC at 1 amp, can be as simple as a DC wall adapter or a pair of 12V batteries wired in series. There's no need for a fancy, electronically regulated unit. Precise regulation, where needed, is already supplied by U2. The external supply should, however, be beefy enough to hold its output voltage within 20%, going from key-up to key-down. For example, a source measuring 25 VDC should drop no lower than about 20 volts when you close the key. The no-load input can be as high as 32 VDC; beyond that point, protection zener D10 may conduct and if it does, it will probably short circuit in the process of protecting the SP-10 from overvoltage.

If you wish to build a power supply from scratch, the classic transformer-rectifier-filter arrangement shown in Fig. 4 will work just fine. Regardless of the power supply you choose, be sure to provide an inline fuse in the plus lead running to TB1-1. Start off with a 1-amp fuse if possible and, if all goes well, upgrade it to 2 or 3 amps for normal operation. This conservative approach to firing up new, untested equipment will minimize casualties should anything be amiss.

Crystals

The operating frequency of the SP-10 is controlled by a single crystal in transmit and receive. With crystals, you give up the ability to wander (or drift!) around the band in exchange for excellent frequency stability, intrinsic dial readout (frequency is marked on the crystal) and simplified project tune-up, requiring very little test equipment. For the beginner, or the old-timer into "radio karma," crystal control is a good way to go.

The actual crystal is a thin square of quartz too fragile and sensitive for direct handling. Rather, it is mounted in a holder which, depending on type, plugs into a crystal socket or is wired directly into the equipment. The octal crystal socket on the SP-10 accepts two of the popular FT-243 holders, having a pin spacing of .486" and a pin diameter of .093." Types HC-17 and Petersen Z-9 are also compatible. In general, any fundamental crystal with a frequency in the chosen band will work if you can adapt it to plug in. For example, even the miniature HC-18 holder with leads instead of pins may be wired to the base salvaged from an unneeded octal vacuum tube, which will then plug in.

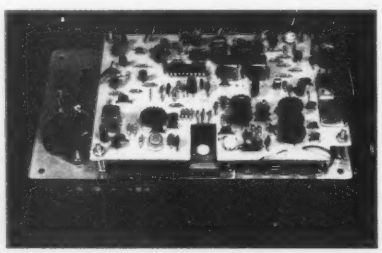

Photo C. The SP-10 at an angle.

Getting crystals is like ordering pizza. Unless you are buying a stock or popular frequency, they are tailor-made by a manufacturer upon receipt of an order. That's why delivery can sometimes take 2-3 weeks or more; you must allow for lead time! Some manufacturers require the Y1 specifications provided in the Parts List while others will do the job if you merely order "amateur-grade crystal" and specify the frequency.

If you're a Novice, don't crowd the edges of your subband when ordering crystals, unless you have the means to ensure the crystal you're using is "in-band." The reason is, a general purpose or amateur-grade crystal ordered for, say, 7102 kHz, may actually put out on 7100. It's a matter of manufacturing tolerance and circuit correlation. If in doubt, give band edges a wide berth.

Tune-Up

The key to a smooth, uneventful tune-up is to do a careful job during construction. Having done your best, let's see if it works! On the PCB, set R19 Bias and R42 Sidetone each to midrange. Connect the power supply to TB1-1 (+) and TB1-2 (-) and a 50-ohm dummy load with relative power meter or wattmeter in line to TB1-3 (coax shield) and TB1-4 (center conductor). Lacking this test equipment, build the simple terminating RF indicator shown in Fig. 5 and connect it to TB1-3 and TB1-4. This gizmo provides a suitable resistive load for low power transmitter testing, as well as a visual (and thermal—it gets warm to hot!) indicator of RF output.

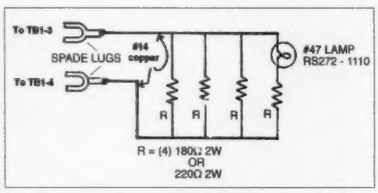

Fig. 5. Terminating RF detector.

Plug a speaker into J2. Insert a crystal into the socket and select it with S2. Switch on power with S1, close the telegraph key and adjust T1 for maximum RF output indication. Adjust R42 on the PCB for desired sidetone level. Replace the dummy load with an antenna or signal generator at the crystal frequency and adjust C23, T2, and T3 for best reception.

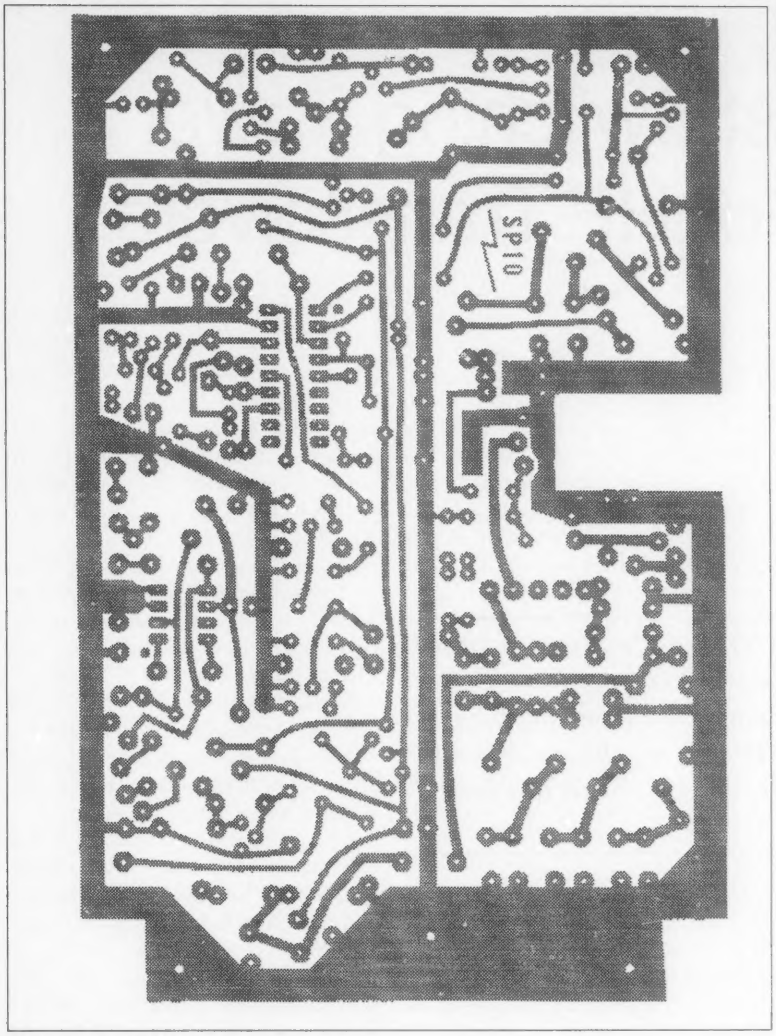

Fig. 2. PC Board foil pattern.

Some patience is called for with the antenna method; you may need to wait for a signal strong enough to be heard through the as yet unpeaked front end. A temporary clip-lead jumper from the anode of D6 to the upper lead of C34 may help by allowing you to get T2 and T3 in the ballpark first. Then remove the jumper to peak C23 and touch up T2 and T3.

On the Air with the SP-10

Like all modern transceivers, the SP-10 prefers to see a 50-ohm antenna system with low SWR. The classic half-wave dipole comes close to ideal without the use of extra matching techniques. Other antennas like the G5RV or random wire will require an antenna tuner to provide an acceptable load. If operation into a less than perfect match is unavoidable, it might be wise to reduce the operating voltage from, say, 24 VDC to 18 VDC. This will reduce the adverse effect (Q9 overheating) of a somewhat high SWR.

With its rather broad selectivity, it can be questionable whether or not signals heard on the SP-10 are close enough to your crystal frequency for a QSO. Those that decrease in pitch and approach zero-beat with RIT control moved fully counterclockwise are very close. Others may be workable if the operator tunes around for your signal.

Though 10 watts is considered low power, it's right up there with the popular one-tube 6L6 transmitter (and countless variations) that propelled tens of thousands of hams into the ether in their early radio careers. The receive section is certainly no worse (and probably better) than those "drifty," broad-tuning superhet Novice receivers we once cherished and still remember fondly. They did the job! And on most any night the SP-10 can be your doorway into a wonderful world of Morse and static, faceless names, exotic places, and colorful QSL cards—all the more exciting when you build the rig yourself!

SP-10 Condensed Parts List

C1-C4, C11-C12, C18, C22, C25-C34	(see table 1)
C23	4-20 pF trimmer, Mouser 24AA022
C56, C57	0.0015-µF Mylar™
D1	MV2104, ECG612
D2, D4-D8	1N914, RS 276-1122
D3	3.3V .5W zener diode (1N5226B)
D9	1N4001, RS 276-1101
D10	33V 1W zener diode (1N4752A)
D11	9.1V .5W zener diode (1N5239B)
J1-J2	3.5 mm closed circuit mini phone jack
L1-L6	(see table 1)
Q1, Q3-Q5	PN2222, ECG123AP, RS 276-2009
Q2	2N2219A, ECG128, RS 276-2030
Q6	MPF102, ECG312, RS 276-2062
Q7	2N6027, ECG6402
Q8	2N3906, PN2907A, ECG159
Q9	IRF530
R19, R42	10k PC trim potentiometer, RS 271-282
R23, R47	10k audio taper potentiometer, RS 271-1721
RFC1	22-µH epoxy coated, Mouser 43LS275
T1-T3	Mouser 42IF123
T4	8 turns #24 enamel wire, trifilar wound on two FT50-43 (Amidon) cores
TB1	4-lug terminal board, Mouser 534-4190
U1	LM386 audio amp, RS 276-1731
U2	7812 voltage regulator, RS276-1771
U3	MC3359P (Circuit Specialists)
Y1	Fundamental crystal, specify desired frequency, parallel / 32-pF load, .005% tolerance, holder type FT-243, HC-17/U or equivalent.

Note: Check the advertising in this magazine for parts suppliers. For a free list of parts sources for this project, send the author an SASE requesting SP-10LST. PC boards and project kit for the SP-10 "Senior Spider" are available from Lectrokit, 401 W. Bogart Rd., Sandusky, OH 44870 (no telephone).

Continued on page 17

Low Cost Switching Power Supply For HF Transceivers

by Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

I have been using a Ten-Tec 938 switching power supply for some time with my Kenwood TS-50S for portable operation. This switching power supply is very small, efficient, and lightweight (2.5 pounds) and lets me operate my TS-50S at 50 watts output continuously. However, for base station use I wanted the full 100-watt output power capability of the TS-50S. A full 20-amp linear power supply weighs three to four times what the TS-50S does, and is two-to-three times larger than the TS-50S. It just didn't seem right to have a power supply that overwhelmed the TS-50S in size and weight. What I wanted was a small, lightweight switcher with 20-amp capability. Unfortunately, no one seems to make these at this time for amateur use, and commercial switchers are very expensive. Oh, what to do!

I, like many of you, receive lots of catalogs of surplus electronic stuff through the mail. Many of these catalogs list all kinds of DC power supplies, both new and used. My favorite surplus catalogs are from Marlin P. Jones & Associates (407-848-8236), All Electronics Corp. (818-904-0524), and Hosfelt Electronics (800-524-6464). I recently noticed that Marlin P. Jones & Associates was advertising a 12-VDC 20-amp switching power supply for only $49. This was a used Lambda power supply that is 9" x 4-7/8" x 2-7/8" and had a shipping weight of only six pounds. This seemed great, but could it be made to operate at 13.8-VDC output? There was only one way to find out—so I ordered one.

"This surplus treasure turned into a 20-amp switching power supply that is smaller than a TS-50S, weighs less than six pounds, and costs less than $60 total!"

A few days later the power supply arrived. It is a used Lambda LYS-W-12 power supply rated at 20 amps continuous at 40 degrees C, 18 amps at 50 degrees C, and 15 amps at 60 degrees C. The input to the supply can be 105–132 VAC at 47–63 Hz, or 130–160 VDC. This power supply has no switches, fuses, connectors, or indicators. When I removed the cover, I found that the DC output connectors were #10 studs on the PC board, and the AC inputs were just pins on the PC board to solder a line cord to. Everything was well marked on the printed circuit board, along with an output voltage adjust potentiometer. So, first things first—could I operate the supply at 20 amps at 13.8 volts? I had a 20-amp load made up of twelve 8-ohm power resistors. I connected a voltmeter and oscilloscope across the load which was attached to the DC studs, soldered an AC line cord to the AC input pins and plugged it in. The output came right up to 12 volts! I next adjusted the voltage adjust pot and easily got 13.8 volts! Finally, I measured 150-mV p-p output voltage and 10-mV p-p ripple on the DC output at full load with my oscilloscope.

Now I needed to make the power supply user friendly—I needed to add a switch, fuse, indicator, line cord, and DC output cord to the unit. This was pretty easy to do as the basic frame that the power supply is mounted in has a number of small unused holes in it. Apparently this chassis base is used on a number of different power supplies. Fig. 1 shows a side view of the power supply with the cover removed and the components I added. On the 4-7/8" x 2-7/8" blank side of the supply, I drilled out the two unused holes on the left side (See Photo A) for a SPST 10-amp switch (Radio Shack RS 275-324), and an LED. On the back, silk-screened side (See Photo B), I drilled out one hole large enough to pass a pair of #12 wires for the DC output, and one hole large enough to take a #8 screw for a ground stud. The photographs illustrate this very well. There is already a "half-moon" cut out in the back that easily passes an AC line cord. On the inside of the power supply, I wired an in-line fuse holder (with a 5-amp fuse) in series with one side of the AC line cord, and wired the line cord to the switch and AC input pins on the printed circuit board. I wired the LED with a 750-ohm series resistor to the solder lugs on the 12-volt studs. Next, I attached #10 solder lugs to the #12 wire that passes out of the supply and then attached the

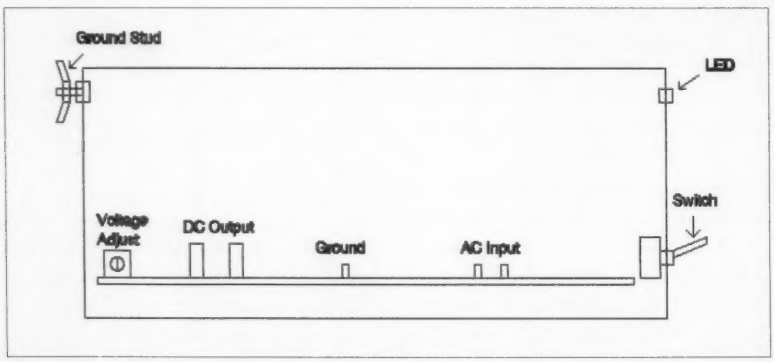

Fig. 1. Switching power supply side view.

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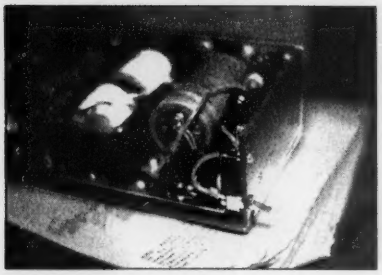

Photo A. Blank side.

solder lugs to the DC output #10 studs. The DC output is floating with respect to ground, so attach a wire from the negative DC terminal to the ground pin on the printed circuit board. Finally, I terminated the #12 wires on the outside of the power supply with a 20-amp Radio Shack "Molex-type" female connector (RS 274-154). The ground stud for tying into your station ground is a #8 screw with the screw head mounted inside the power supply. Use lock washers inside and out, and a #8 nut on the outside to hold it in place. I used a #8 wing nut and two #8 washers to make an easy-connect ground stud.

That's it. This surplus treasure turned into a 20-amp switching power supply that is smaller than a TS-50S, weighs less than six pounds, and costs less than $60 total! And, it is perfect for both base station and portable use. Since this is a surplus power supply, it will probably show up from time to time in different surplus catalogs. So, keep your eyes out for this or similar power supplies. These commercially rated switching power supplies are real treasures and are adjustable for amateur 13.8-volt DC power requirements. 73

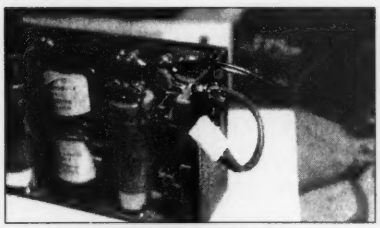

Photo B. Back, silk-screened side.

The SP-10 "Senior Spider" *Continued from page 15*

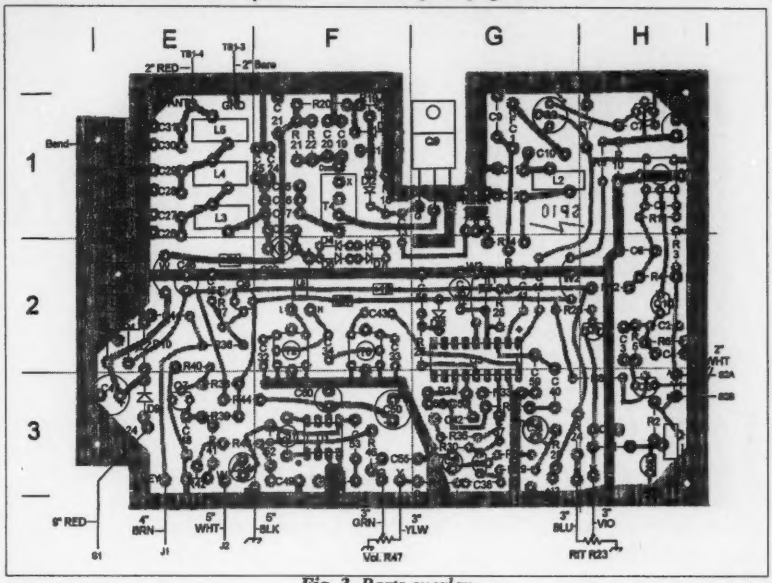

Fig. 3. Parts overlay.

Table 1 Band Data

Component	80-M	40-M	30-M
C1	390 pF	68 pF	Not used
C2	18 pF	5 pF	Not used
C3	680 pF	270 pF	Not used
C4	820 pF	680 pF	390 pF
C11, C12	820 pF	390 pF	270 pF
C18, C34	39 pF	18 pF	10 pF
C22	18 pF	Not used	Not used
C25, C31	390 pF	270 pF	180 pF
C26, C28	390 pF	Not used	390 pF
C27, C29	820 pF	680 pF	68 pF
C30	68 pF	Not used	Not used
C32, C33	390 pF	68 pF	Not used
L1 (FT37-61)	40T #30	23T #28	17T #28
L2 (T50-2)	22T #24	14T #24	12T #24
L3, L5 (T50-2)	22T #24	17T #24	14T #24
L4 (T50-2)	25T #24	19T #24	16T #24
L6 (FT-37-61)	30T #28	25T #28	15T #28

Capacitors are 100v ceramic disk type. For inductors, wind turns using the enamel wire gauge given on the toroid core specified.

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I consider a "good" mobile radio installation one that is unobtrusive. With the variety of radios with detachable control panels, it's fairly easy to go mobile without having your car's interior resembling something like the space shuttle's cockpit.

As a further aid in achieving an unobtrusive installation, many vehicles include one or more blank DIN panels on the dashboard, sized perfectly for installation of many of the detachable control panels. I know of one instance where a ham was able to install an entire Kenwood TS-741 in place of such a panel, and when he completed the installation it looked like a factory original option.

I have one problem with unobtrusive installations, though: Unobtrusive means not noticeable, which means I can forget to shut my radio off when leaving my car. Even those "wheat grain" bulbs can kill a battery, given enough time.

The Ignition Key Control Solution

Because of my forgetful nature, I like it when everything turns off when I remove the ignition key. Achieving total key shutoff can be complicated since most manufacturers recommend connecting the radio's power cable directly to the battery. This is particularly important with 100-watt class radios, which use a lot of current. Also, many manufacturers recommend shutting your rig off when starting the car's engine. That's because radios can be intolerant of irregularities in their power source. The starting process can produce deep sags in the vehicle's supply voltage and high amplitude spikes, which could zap your radio.

To meet my first need (direct battery connection), I used a relay mounted in my engine compartment near the battery (Photo A). Use of a relay is a legitimate method of connecting power to a radio. The relay I used is one commonly used in mobile two-way radio installations. I got it, together with a fuse block, from a local two-way shop. It can handle 30 amps continuously and has an 80-ohm coil.

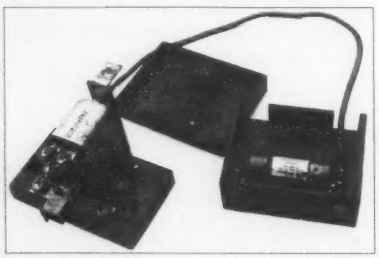

Photo A. *Typical control relay and fuse block suitable for use with 100-watt mobile radios.*

I've seen similar relays for sale at auto accessory shops as horn-relay replacements. The relay's contacts should be rated for at least 50% more current than the specified maximum current of your radio, and the relay should be a sealed type (no sparks).

The power control relay must be well secured to the vehicle. The relay and fuse block should be screw-anchored to the inside wheel-well cowling or some other suitable surface near the vehicle's battery. Locating a place can be a challenge in some feature-packed cars. A vehicle's engine compartment is no place for loose items. Also, check out what you might be drilling into before drilling.

Many vehicles use batteries with side connection lugs. I've seen some "interesting" wiring techniques done

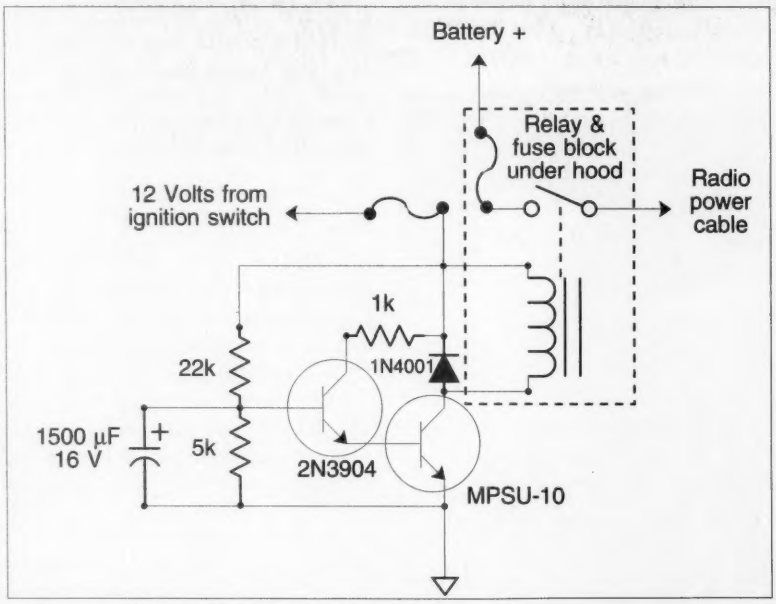

Fig. 1. *The on-delay timer circuit.*

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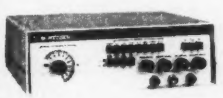

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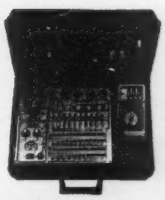

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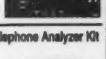

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when trying to connect a radio cable to this type of battery. Most auto accessory stores carry an adapter block for connecting auxiliary wires to such batteries; I recommend using one.

An On-Delay Circuit

A simple method of controlling the power relay circuit would be to tap into the car's accessory circuit, such as at the car radio's fuse. Most vehicles are wired so that the radio's power turns off when you're starting. While this works OK, I didn't like power coming on, dropping out, then coming back on again, so I decided to use a delay circuit that would keep the power relay from energizing for a few seconds after key-on.

After failing to make something simple using a 555 timer IC, I settled on the circuit shown in Fig. 1. I used two transistors I had available because I needed a combination of a relatively high RC time constant circuit that limited the base current, together with high current switching. You could probably substitute a single, high-gain Darlington-type device and get the same results.

Using the values shown, the circuit provides about 10 seconds delay before the relay pulls in. I built the circuit on a small piece of perf board, as shown in Photo B. The circuit layout is not critical, although it should be built to fit some type of enclosure that can be secured to the vehicle somewhere out of the way, like up under the dash.

I used a 1,500-µF capacitor as the basic time-delay element. It charges through a 22k-ohm resistor until the 2N3904 is forward biased and conducts, thereby switching the MPSU-10 on. If you want to change the time delay, substitute other capacitor values. Don't tinker too much with the resistor values as they were selected to produce the proper base-emitter current flow. Note that I used a 1k-ohm resistor in series with the 2N3904's collector. This resistor limits the MPSU-10's base-emitter current, and it also serves to keep the 2N3094's collector current within proper limits.

I mounted my entire assembly inside a small snap-tight plastic box and drilled holes for the wires. The only connections necessary are the source of key-switched +12 volts, ground, and the relay coil return.

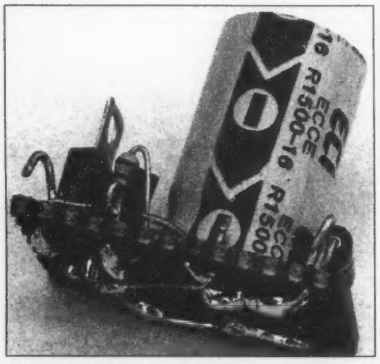

Photo B. The on-delay timer construction details.

Connecting to the Vehicle's Key Circuit

A convenient method I've used to pick up key-switched +12 volts is by using a modified "blade" type fuse (Photo C) and inserting it into an unused slot in the vehicle's fuse block. Most newer vehicles use this type of fuse, and I can usually find an unused spot in the fuse block that is key-switched.

"The judicious use of fuses is very important when doing automobile wiring (note the in-line fuse I use with my modified blade fuse)."

In the event there is no available slot for the fuse, you can substitute a modified fuse for an existing fuse, e.g. the radio fuse, but if you do I would recommend modifying a fuse that is rated correctly, not the 20-amp one I used. The judicious use of fuses is very important when doing automobile wiring (note the in-line fuse I use with my modified blade fuse). I used a 1-amp fuse in the line to my delay timer circuit and power control relay.

One note of caution if you decide to replace the broadcast radio's fuse: My newest car has a factory radio that's equipped with a password-protected theft-deterrent feature. If this radio is disconnected from battery power without defeating this protection scheme, the radio will become totally useless when reconnected. I'm told not even Delco can help if you turn this feature off. It would be wise to check with your dealer to find out if you may have such a radio prior to disconnecting it!

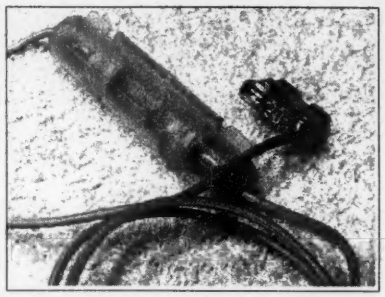

Photo C. Modified "blade-type" fuse useful in connecting to a car's key-switch circuit.

While on the subject of fuses, if there's a rule to consider above all others, it's fuse everything! Don't underestimate the dangerous potentials of an automobile's electrical system because of its low voltage. A car's battery is a powerful energy store that can produce explosions, fire, and bodily harm, if not treated with respect.

Special consideration should always be given to vehicle wiring. From a general safety standpoint there should never be any loose wires. Wiring in an engine compartment should be routed to be clear of any potential hot spots, e.g. exhaust manifolds, etc. Locations near fans, pulleys, and belts, should also be avoided. After locating a safe path for running wires in the engine compartment, the wires should be tied down using cable ties.

The radio's controls should be located such that you do not have to take your eyes off the road to operate the radio.

Safe mobiling, everybody! 73

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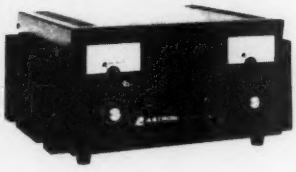

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- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
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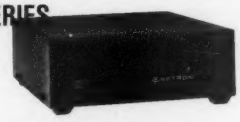
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES



- LOW PROFILE POWER SUPPLY

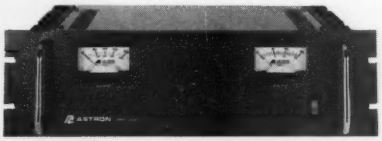
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅞ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅞ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

- POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

Going Public

Put a different kind of ham on the screen!

Jeff Brone WB2JNA
108 Shiley St. Apt. B
Annapolis MD 21401

We need to make the public more aware of what we do. As ham operators, we could benefit much by enhancing the public's knowledge of our hobby. The rewards would be great. We could gain operators and have more influence in the world. The prestige we acquired would give us power, expand our possibilities, and maybe even help us get better tables at restaurants. In the past I have mentioned to headwaiters that I was a ham, but it did me little good, although I knew that they were impressed because they did that thing that people do when they're trying to hide their being impressed. Their eyes glazed over and they looked bored. I wasn't fooled by that, but I was still disappointed with my table. Think about this: We hams have a very exciting hobby. We handle emergency messages in disasters; we communicate with people all over the world; we further good international relations; and we use solder! What we do is fascinating, yet relatively little is known about us by non-hams. Why? In a word: popular culture.

Americans love their TV and movies, and we hams just haven't been exposed enough in those avenues. I believe that in the TV program "Alf," Willie, the father, is a ham, and in "The Simpsons," one of Marge's sisters is a ham, as is Bart's schoolmate who calls himself, appropriately, "Ham" (the boy is kind of a nerd, which really doesn't help us). Radio communications plays a part of most every deep sea submarine movie, but that's only tangential publicity for us. I do remember that in the Mel Gibson film "The Man Without a Face," about a deformed, lonely ex-schoolteacher, I was sure that I saw some QSL cards on the wall of his character's house. Still, these are small victories. If we are to break into the public's mind, it's going to have to be by our own hand, or, as I shall explain, pen.

The solution is simple: Write the vehicle ourselves. We need to write the screen play or TV show that will give us the notoriety we so deserve. With that in mind, I have come up with some ideas for just that exact movie or TV program that will do the job. And yes, I will remember all the little people that I met on the way to the top.

First, I propose a TV situation comedy. America loves them. and the right ones capture the imagination of the whole country. Mine is a delightful, family-oriented comedy about Marconi- I call it "Darn that Guglielmo!" In it, Marconi is an average-guy brilliant inventor just trying to make ends meet and keep his family happy. I envision one episode where his wife is out of town and he has to make dinner for his two children and his tough old boss, Mr. Prendergast. The usual comic machinations ensue: Marconi lets the rice boil over, he puts too much soap in the laundry, and he discovers wireless radio and forever changes the face of communications. Also, I think something really funny could happen with some spaghetti, though I haven't worked out the details on that one.

I'd like to see Tony Danza in the title role– he's funny, he's likable, and he's Italian. I think this show would be very popular with brilliant European inventors living in New England and the Canadian Maritime Provinces. I've heard that is a very important market group.

My next idea is exciting because, at last, we have a "ham radio hero" in a feature film. It concerns a combination ham and martial arts expert who specializes in CW operating. I call it "Morse Code of Vengeance." As a young child, he was very shy and had difficulty talking with others. He finds himself through two pursuits: CW ham operating, because it allows him to overcome his fear of speaking up; and martial arts, because it allows him to break things. As he matures, he blends the rhythms of self defense movements with the rhythm of CW. Later, he is called on by his government to break up an international ring of electronic equipment thieves. This film has everything: action, adventure, romance, and electronic keyers. In the final scene the hero, and a small group of elite commandos, dressed in green military fatigues and callsign baseball caps, infiltrate the criminal's lair while they communicate on HTs. As the hero confronts the head thief in a final showdown, the hero dramatically challenges his foe with "C'mon baby, let's QSO."

I'd like to add that there's no reason why the hero in this film can't be a woman, with very few plot changes necessary. Use of a female hero may make the film even more popular, although its name should be changed. Some suggestions are "Velvet Fist of Revenge" or "YL: This Time It's Personal."

Made-for-TV movies have a large following, and we could certainly tap into this market. My idea is a steamy romance called "CQ for Desire." It has deep emotional conflicts, searing passions, and radio equipment. Eddie Ribalski, a rough-edged longshoreman ham in Galveston, TX, uses the legal limit of output power and wouldn't think of operating without his linear amplifier turned on. He loves his loyal wife, Linda, and everything is fine until he meets Heather Arnold, a career woman who has risen to the top of the breakfast cereal buying industry and operates only low power. Initially, Eddie hates her, but they gradually become friends until that climactic night when he takes her into his shack and lets her operate his rig. She is intoxicated by the power and can't get enough of it. He is thrilled by his influence over her and lets her operate whenever they can meet. They know it's wrong, but they can't stop. Finally, Eddie's wife finds out and confronts him about the relationship. He vows to break it off, and Eddie and Heather meet later on a windy hilltop, right next to Eddie's antenna tower. They say good-bye, and Heather tells him, "It was too much, far too much for either of us to control, but a little bit of you will be in my feedline forever."

I know what you all must be thinking: "How can I come up with brilliant concepts like these?" I must admit, I have a lot of ideas, so many that it's kind of scary. Actually, my friends call it "disturbing," but you see my point. However, you can have lots of fun getting ham radio into the mainstream in other ways. Get involved in a special events demonstration station, teach a class in radio, show a friend or neighbor your rig, or just let your natural enthusiasm show as you describe your hobby to your friends or co-workers. If you find yourself getting really carried away, take a deep breath and repeat quietly "Boy, this is fun."

Please, don't steal any of these ideas. 73

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Tesla:

Bust The Smithsonian

John W. Wagner,W8AHB
3890 Tubbs Road
Ann Arbor MI 48103-9437

In the spring of 1983 I was browsing through the Allegheny College Library and found a book titled *Prodigal Genius, The Life of Nikola Tesla* by John J. O'Neill (1944). I had known about Tesla and his famous coil from my high school days 40 years earlier, but this was my first opportunity to learn more about the man whose coil made fascinating sparks. Regrettably, his coil was the sorrowful extent of my knowledge of Tesla, and likely it is as much as most people know, if indeed they recognize his name at all.

The first two pages of O'Neill's biography are powerful. After more than 12 years I can't forget his words. In short, I deem it a book of epic proportion. When I looked at the inside of the back cover, I was amazed to find that the book had been taken out only eight times in the past 38 years. How could this be? Was I overestimating the importance of its message? I didn't think so, and I still don't.

The same can be said for the next Tesla biography I discovered, *Tesla, Man Out of Time* by Margaret Cheney (1981). It has a powerful introduction by Leland Anderson, our country's foremost authority on Tesla. It is by far the most completely documented book available today on Tesla.

Class Hero

I had been teaching English Composition and my first thought was, "How interesting it might be for my students to learn the story of Tesla's life—it just might help me breathe some fire into their writing." The more I read, the more I was able to impart to my students, and the more they became inflamed with enthusiasm—not only for writing but for a desire to wave Tesla's banner. It seemed we had discovered a secret, if not an outright flaw in history. Why was it that so few people had

ever heard of Tesla? We decided to write letter stories to people and tell them about our discovery.

At first, and without realizing it, Tesla had become our class hero, and my students now became excited about writing. We developed a mission—to tell as many people as possible about Tesla. I was reveling at the writing successes in my classes, so I continued this activity with succeeding classes for several years.

One school year, 1986-87, was particularly exciting. Someone brought to our attention an interesting situation that existed in Madison, Wisconsin. We learned that several years earlier someone had named streets after famous scientists, including Tesla and Marconi. The city fathers spelled "MARCONI" correctly, but somehow they had misspelled Tesla's name as "TELSA" on their street sign. We also learned that a University of Wisconsin professor and chairman of the History Department had petitioned Madison officials to correct the spelling of Tesla's name, but his pleas to City Council were rejected repeatedly until he finally abandoned his crusade.

This was exactly the sort of challenge my students wanted and needed. We bombarded Madison with letters to City Council, the newspaper, residents on "TELSA" Street, the mayor, and even the mayor's wife, chiding them to correct Tesla's misspelled name. We argued, "After all, Tesla was an honored American citizen who gave much to the world;" and, "How would they like to see Washington's name spelled incorrectly on street signs?" The dispute raged for months and our story made the front page of the *Wisconsin State Journal*. One council member was particularly distraught over the issue. He called one day and begged in so many words that we "get off their backs." We refused to relent because we knew we had truth on our side. Five months later we received a letter from the City Clerk advising us they had corrected the street signs. This was confirmed later by a photograph one of my students took while traveling there.

One Saturday morning two years later my doorbell rang. It was a former student and her father. She told me that for the past three years she had not forgotten our Tesla story. It had made such an impression on her that she had persuaded her father, an accomplished sculptor, to render a Tesla bust for our class... that is, if this was something I really wanted. It took about a microsecond for me to agree to their generous offer. They explained that I would have to pay for the materials, but there would be no charge for the work. I was ecstatic and many thoughts ran through my head. We could put the bust in our classroom, or perhaps donate it to some museum.

When the clay model took better shape and I could see how magnificent it really was, the sculptor asked what preference I had for the final cast. We decided on bronze. We also decided on a granite base and a bronze plaque telling of Tesla's

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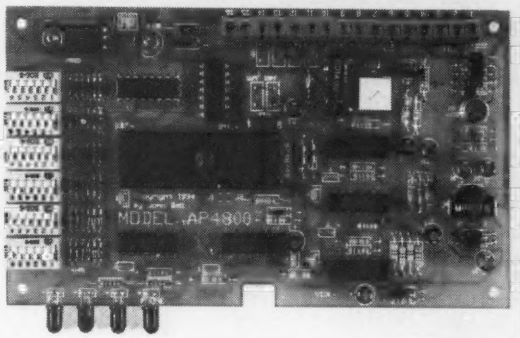

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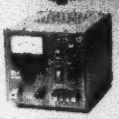
CIRCLE 27 ON READER SERVICE CARD

PS-400X

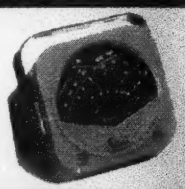
RS-300



PS-50TM

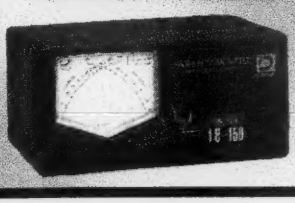
Model		PS-400X	RS-300	PS-50TM
Input Voltage		AC 230 or 117VAC on ODR, ±5%		
Output Voltage		1-15VDC variable		13.8V fix.
Output Current	MAX.	40A	30A	5.2A
	Rating	32A	24A	4.2A
Votlage Fluctuation		Less than 1%		Less than 2%
Ripple Voltage		Less than 3mV (with rated output)		
Protection Circuit		when 42A	when 32A	when 5.2A
Dimensions (WHD, MM)		216x110x280	172x150x240	135x87x200
Net Weight		8.5kG	8.9kG	2.5kG
Power Consumption		690W max.	600W max.	120W max.

CN-400 Series



Model	CN-410M	CN-460M	CN-465M
Freq.	3.5-150MHz	140-450MHz	
Power Forward	15 W/150 W		15 W/75 W
Range Reflected	5 W/50 W		5 W/25 W
Tolerance	Better than ±15%		
SWR Detection Sensitivity	3 W min		
Dimensions/weight	71W x 78H x 100D mm/300g		

CN-101 Series



Model	CN-101L	CN-103L
Freq.	1.8 - 150MHz	140 - 525MHz
Power Range	15/150/1.5kW	20/200W
Power Rating	1.5kW (1.8-60MHz) 1kW (144MHz)	200W (140-525MHz)
Tolerance	±10% (of full scale)	
SWR Detection Sensitivity	4W min.	

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eminence in the field of electrical science. I worked for weeks at my computer keyboard composing various inscriptions for the plaque and consulting Margaret Cheney and Leland Anderson for guidance. Finally, I decided to use the following inscription:

NIKOLA TESLA
1856 - 1943
HIS NAME MARKS AN EPOCH
IN A SINGLE BURST OF
INVENTION HE CREATED THE
POLYPHASE ALTERNATING CURRENT SYSTEM OF MOTORS AND
GENERATORS THAT POWERS OUR
WORLD. HE GAVE US EVERY
ESSENTIAL OF RADIO, AND LAID
THE FOUNDATION FOR MUCH OF
TODAY'S TECHNOLOGY.

There will probably be several readers who might wish that I had said something else on this plaque. Nevertheless, these were Tesla's greatest achievements.

Placing the Bust

My youngest son told me about a band in California named TESLA that might be interested in contributing to our campaign. I wrote to them. In a few weeks their drummer and a guitar player responded personally with a check for $1,800. In addition, we wrote to dozens of CEOs of power companies and large corporations. Many responded with checks of $50 to $100. It seemed we were making real progress because many people in high positions were sympathetic to our message.

As we struggled deciding where to place our bust, someone suggested the Henry Ford Museum in Dearborn. They have an entire section of their museum devoted to the history of electrical science. We believed they would welcome with open arms a bust of this caliber for their display.

When I drove to Dearborn to confer with their head curator, I showed him a large full-color photograph of our bust and told him our story about how it came into being. Then, on behalf of my students, I offered the bust fully expecting that he would accept it. After all, the bust was magnificent and had an appraised value of $6,000. I was struck dumb when he refused our offer. It was simply beyond my comprehension that such a prestigious museum would refuse to accept and display the bust of America's greatest inventor in electrical science. As I left the building, admittedly dazed, I noticed a huge model of the Statue of Liberty featuring an Edison display. The theme was a celebration of Edison for making possible the electrical energy needed to illuminate our national monument. It was apparent AC power was celebrated rather than Edison's incandescent lamp.

As I walked out the door I looked back, and there above the entryway I saw an inscription I had apparently missed when I first entered. It read, "The Edison Institute." Now everything suddenly fit into place. Edison and Ford were close friends, and it was reasonable to expect the Ford company would continue to celebrate Edison's name. I thought, "There must certainly be other museums that would not have this kind of bias," so I visited the Chicago Museum of Science and Industry. I concluded it was nothing more than a haven for commercial displays—certainly nothing to compare with, say, the Toronto Science Museum. Canada was out of the question though because we wanted to keep the bust in this country.

Finally someone suggested we go to the top—to the most august institution of them all, the Smithsonian. It is the one place in our country where only the greatest have their places in history preserved forever...men such as George Washington, Thomas Jefferson and Joseph Henry. Certainly their officials would understand and appreciate Tesla's stature.

"It was simply beyond my comprehension that such a prestigious museum would refuse to accept and display the bust of America's greatest inventor in electrical science."

I reasoned they probably had already recognized Tesla's accomplishments and might have a bust, so I decided to travel to Washington in 1988 to visit the Smithsonian's National Museum of American History. I had visions of seeing nothing but the grandest of sculptures and extensive displays. Upon arriving I discovered that the electrical section was closed for renovation. When I explained to officials my purpose of coming to Washington, I was treated to a personal tour of their archives by none other than the curator's assistant. He gave me a book describing their displays, but I was also able to see a part of the museum that was not open to the public. There were numerous busts, but none were so great as to make our bust seem inferior. Therefore, I saw no reason why the museum could possibly refuse it. I returned to Ann Arbor with the book under my arm and feeling as if my trip had been a success. All that remained was to make our formal offer and our project would be finished.

When the bust was finished, one of my students volunteered to write to the museum. In a few days we received a reply from Dr. Bernard S. Finn, curator of the Division of Electricity and Modern Physics. He did not want the bust! My students were devastated, and again I was struck dumb. He explained they 'almost never collect busts in their Division.' Later, a friend who had visited the museum and taken photographs sent me one revealing that Dr. Finn was displaying Edison's bust next to Tesla's first AC motor/generator. Tesla's U.S. patent number appeared on the motor/generator, but the display was arranged in such a way as to give credit to Edison. Needless to say, I was astonished.

Further investigation revealed we were not the first group pressuring Dr. Finn to recognize Tesla. Several years earlier a congressman had chided Finn to create a Tesla display. The display prepared by Dr. Finn consisted of a small glass showcase housing a few insignificant personal artifacts. The showcase was placed in a darkened hallway next to the men's room, while the main gallery was devoted to an elaborate Edison display.

By this time I had thoroughly read Dr. Finn's book, *Lighting a Revolution,* given to me by Finn's assistant when I visited the museum. My first *73 Amateur Radio Today* article (December 1995) describes Finn's section titled, "The Beginning of the Electrical Age," naming 43 contributors to the science of electricity. Tesla's name was omitted! This was particularly disturbing because, in describing the Niagara Falls Power Project, Dr. Finn alluded to Edison's genius that made the Niagara project possible: "When the Niagara Falls power station began operating in 1895, it signaled the final major act in the revolutionary drama that began in Menlo Park in the fall of 1879." In other words, in 1879 Edison invented DC electricity! Then, in 1895, he invented AC and harnessed Niagara Falls! The historical truth of this episode is that Edison fought the rise of AC and played no role whatever in the Niagara Falls power project. An acknowledgment on the inside of the book revealed that its funding was made

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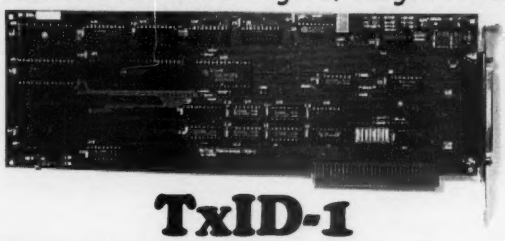

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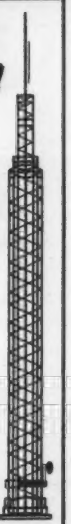

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possible by the Thomas Alva Edison Foundation. I wondered if Dr. Finn's depiction of electrical history was highly biased toward Edison because funding for the book came from the Edison Foundation?

In *Science,* Vol. 245, July - Sept. 1989, p.768, a book review titled "The Real Edison, The Making of an Inventor," by Reese V. Jenkins et al., Eds. Johns Hopkins University Press, Baltimore, 1989, carries a most revealing observation: "This volume renders untenable the popular view of Edison as a Merlinesque figure who wrestles with mysterious forces and single-handedly conjures up stunning inventions."

My daughter teaches physics and chemistry at a nearby university. I asked her to involve her physics students in my campaign. They wrote numerous letters to the secretary of the Smithsonian besieging him to accept our bust. All responses were negative because the Secretary was determined to back Finn's personal bias toward Edison, amounting to the virtual exclusion of Tesla.

One of my students suggested we make promotional T-shirts and sweatshirts to sell. We decided to put a picture of our bust on the front. My wife, who is usually not vocal, suggested we use the caption, "BUST THE SMITHSONIAN." We engaged an artist to create a seven-color likeness of Tesla including several symbolic figures representing highlights in his life for the back of the shirts. The artwork and silk-screening would be complex and we could find only one firm in Ann Arbor able to do the work. The end product was magnificent! We sold hundreds of shirts in nearly every state, the proceeds going into a charitable account for two additional busts soon to be cast.

My next move was to write to U.S. Senator Carl Levin from Michigan, asking if he could exercise some of his political clout on the Smithsonian. Several letters were exchanged, but they had no apparent effect. Then, in one final effort, Senator Levin, on July 10, 1990, stood on the floor of the U.S. Senate and delivered a scorching account of the Smithsonian's historical debacle regarding Tesla (*Congressional Record,* Vol. 136, No. 86): "...Nikola Tesla has not been granted his proper place in history. In the Smithsonian Institution, for example, Mr. Edison's inventions are justifiably well represented. However, although the museum has included Mr. Tesla's alternating current generators in their exhibit, no mention is made of Mr. Tesla. In fact, the generator is included as part of the Edison exhibit."

At this time several Michigan newspaper articles telling our story appeared in Detroit and locally. Later, an Associated Press writer put the story in newspapers throughout the country. I even received one report the article was seen in a Hong Kong newspaper. All this publicity had no effect on Smithsonian policy. However, the secretary finally promised to have Dr. Finn create a significant Tesla display in 1993. Their plan was to commemorate the hundredth anniversary of the Columbian Exposition in Chicago. This was the first World's Fair, brilliantly lit by electricity—the same AC that powers the world today, made practical by Tesla's genius.

"If, on the other hand, a club or perhaps some students read this story and want to become involved, either by radio or on the Internet, they could make their feelings known."

I sensed that the secretary was only buying time and that some excuse would be found not to give Tesla his due. It was not long before my apprehension became reality. Dr. Finn was relying on obtaining a few Tesla artifacts held in a Yugoslavian museum. Soon thereafter the war in Yugoslavia erupted. Now Dr. Finn uses the war as an excuse not to create a Tesla display. The Yugoslavian museum items he deems so important for his proposed display are only insignificant artifacts...a suit of clothing, a cane, a pair of shoes, a suitcase, etc. Obviously, the public would not relate these items to Tesla's greatest contributions—his rotating magnetic field principle and his basic four-tuned circuit forming the necessary element of radio. Dr. Finn's plan is to explain Tesla as an eccentric loner who remained outside the arena of mainstream academe and industry. Would not science history be better served if he highlighted and paid tribute to Tesla's greatest contributions? These fundamental discoveries serve as the foundation for our two most important industries—power and communication.

It was Hans Christian Oersted discovering electromagnetism in 1820, followed by Michael Faraday making the first electromagnetic generator in 1831, that really opened the age of electric power. Tesla's rotating magnetic field principle indeed "signaled the final major act in the revolutionary drama"... but that drama began with Oersted and Faraday, not with Edison at Menlo Park!

How to Protest

The Smithsonian was criticized severely recently, and rightly so, by veterans groups and others for their wrongful depiction of history regarding the bombing of Hiroshima and Nagasaki. The outcry was so loud that Smithsonian officials had to modify their Enola Gay display. I see little difference in the historical bias the Smithsonian shows against Tesla and the nonsensical bias they preferred regarding the Hiroshima and Nagasaki bombing. Of course the main difference in these disputes is that Tesla does not have large segments of the general public complaining to Smithsonian officials.

When Wayne Green asked me to write a second article for *73 Amateur Radio Today,* I wondered who in the amateur community really cares anything about Tesla or the Smithsonian's depiction of electrical history. I also wondered what I might expect to accomplish by writing a second article. The logical answer to that question is, "probably nothing," because amateurs comprise a small group...certainly not even close to the size of a national veterans group. Therefore, I cannot expect a large outcry of protest to the Smithsonian. If, on the other hand, a club or perhaps some students read this story and want to become involved, either by radio or on the Internet, they could make their feelings known.

Unfortunately, the Smithsonian is a political organization, much the same as many other groups in Washington—they blow in the direction of the wind. I believe the wind has been blowing for too long in Edison's direction, particularly in regard to his entrepreneurial experiment with DC power. I want to see credit given where credit is due...to Tesla for his polyphase AC system...the system that works.

The History of Technology faction that has emerged in recent years has subverted our national museum and converted it into an advertising medium promoting specific industries that support them financially. Also, the group that has assumed power at the Smithsonian is methodically dismantling and converting our national museum into an instrument for social change. What was once a tribute to America is gradually

Continued on page 30

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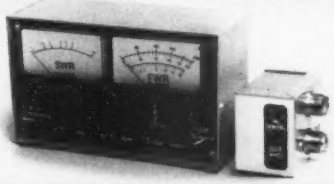

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Tesla:

Continued from page 28

being transformed into an assault on American history. I strongly suspect these issues were not even imagined by Mr. James Smithson, a genteel and erudite Englishman, when he bequeathed his estate to the government of the United States to establish the Smithsonian "for the increase and diffusion of knowledge." Smithson was a scientist and man of letters, not a social activist. He undoubtedly envisioned a museum that celebrated creativity rather than entrepreneurship, and tasteful displays depicting an accurate account of our society's accomplishments rather than focusing on its problems.

One way of changing the direction that the Smithsonian has been heading is by voicing strong opposition to its head: Mr. Ira Michael Heyman, Secretary, Smithsonian Institution, Washington, D.C. 20560

Much of the change in focus at the Smithsonian started with its former head, Secretary Robert McCormick Adams who retired in 1994. It appears that Secretary Heyman intends to continue the course started by Mr. Adams. If any readers feel obliged to write to Secretary Heyman, I would be pleased to receive a copy of your letter. 73

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The circuit is dirt simple and can be hard-wired or you can use the PC board accompanying this article. All the parts can be mounted on a 2" square circuit board and will fit into a "wall transformer" case from which the transformer has been removed. However, I'll leave the cabinet or enclosure choice to you.

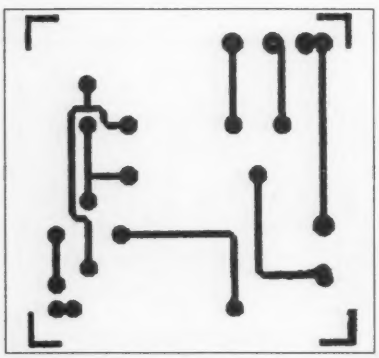

Fig. 1. The foil side of the board.

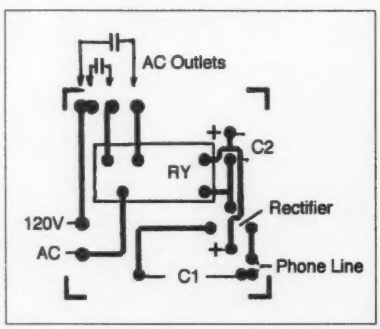

Fig. 2. The component side of the board, showing parts placement.

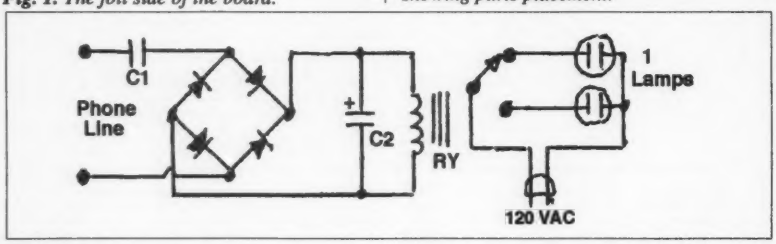

Fig. 3. The circuit diagram.

In my case, I chose a 48-volt SPDT relay because the ringing voltage is approximately 48 to 50 volts.

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RG58/U 95% BRAID	.15/FT	.13/FT
RG58A/U 95% TC BRAID	.17/FT	.15/FT
450 OHM LADDER LINE	.12/FT	.11/FT
440 OHM LADDER LINE 16GA STRANDED	.18/FT	.17/FT

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50FT RG8/U FOAM 95% BRD UV RESISTANT JKT 1.2dB @ 50MHz	$22.50/EA

ROTOR CABLE	100FT	UP500FT
5971 8/COND (2/18 6/22) for runs up to: 125ft BLK UV RES JKT	.20/FT	.19/FT
4090 8/COND (2/18 6/20) for runs up to: 200ft BLK UV RES JKT	.35/FT	.34/FT
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12GA 19/25 "BARE COPPER" UNINSULATED	.13/FT	.11/FT
16GA 26/30 "BARE COPPER" PVC INSULATED	.09/FT	.07/FT
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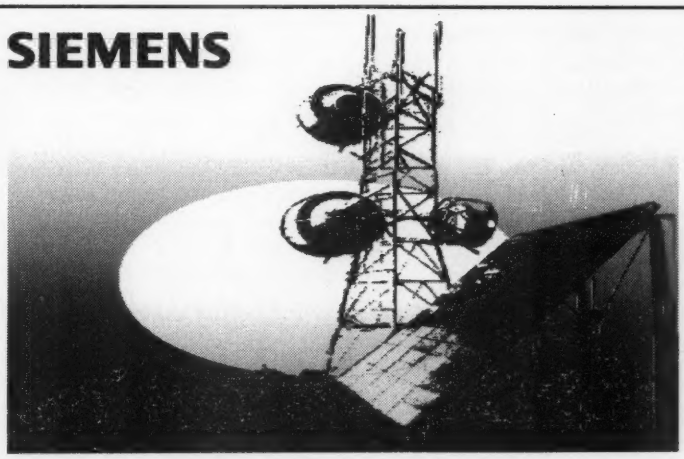

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I have been using the sun's energy since 1978. I've designed thousands of systems worldwide through my SunLight Energy Systems company. However, my personal favorite just happens to be located a few miles from my home. It's the home of Clyde "Chuck" Davis WA8YGU. Chuck, like me, has always been interested in solar power. Pushed by the ever increasing cost of electricity from the power company, environmental concerns, and self-sufficiency, he contacted me. Let's take a closer look at his "system" and how it came to be.

Design Goals

Chuck wanted a system that would power his entire home. Some of the loads included were the furnace, washer/dryer, refrigeration, and a small air conditioning unit. Chuck also operates a 24-hour landline-based BBS. Several computer calculations showed that the amount of energy required per day was about 50 kW/hours. At the current cost of grid supplied electricity, Chuck's average monthly electric bills were peaking about $160 a month.

Since most of the loads specified were AC, all loads would operate from a DC-to-AC sine wave inverter. A sine wave inverter was chosen since several of the AC loads would operate unsatisfactorily under the modified square wave some inverters use.

The Solar Panels

Most hams would look for the cheapest solar panels. In a design like this one, there were several other factors that had to be included. Aside from the actual cost of the panels, we had to take into account the required panel mounting structures and the labor required to install the panels. Smaller wattage panels, while less expensive, require more mounting space for a given amount of power. The added cost of interconnecting wires and cables also had to be taken into account.

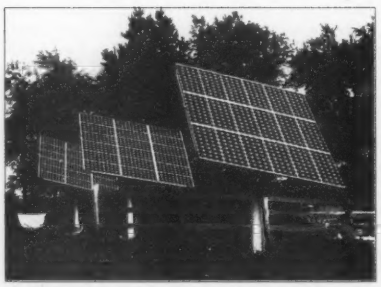

Photo A. *The three arrays keep the battery bank fully charged, providing all the power needed for the home and hamshack.*

On my first rough draft, I suggested two types of panels. The first was the Solarex MSX-64. This polycrystalline panel produces 64 watts under standard test conditions. Its large extra-heavy frame makes it an ideal unit to use in our local climate. It uses standard 1/2-inch electrical conduit, making the interconnection between modules neat and easy. And it comes with a 20-year warranty against power loss.

The second module I recommended was the Siemens ProCharger PC4-JF. It's made of single-crystal cells and produces 75 watts under standard test conditions. As with the Solarex panel, the PC4-JF will also accept standard electrical connections via its junction box. It also has a built-in bypass diode. This is different from a blocking diode in that a bypass diode will shunt current around a shaded panel, protecting it from damage. It has a 10-year warranty against power loss, and costs less than the Solarex panels.

Chuck decided to go with the Siemens modules. Given an array of 18 panels, the difference between the two would be a total of 190 watts! That extra 11 watts each panel produces would equal more than two MSX-64 panels, when configured in an 18-panel array. With a planned three arrays, that's an extra nine panels at a cost of zero dollars.

Naturally, right after the first PC4-JF had arrived, Solarex announced a new, higher-power version in its MSX "MEGA" series. Had the new MSX-83 (83 watts vs. the 75 watts of the PC4-JF) been available, then the MSX-83 would have been our choice.

There are 18 panels in each array. The panels are wired in series to provide a 24-volt system. The system voltage was determined by the inverter, as I'll explain later on.

Each subset of 24 volts is wired in parallel with the rest of the array. So, of the 18 panels, 9 are in series and 9 are in parallel. Each array then produces a total of 918 peak watts. That breaks down to 27 amps at 34 volts. The entire system produces just short of 3kWpa (peak array).

All three arrays are wired the same. The power from each array is combined in junction boxes at the base of arrays #1 and #2. From the junction box, there are four runs of four-ought weld cable routing the power into the battery storage area. Along with the power cables, several runs of "data" wires were also pulled though the 4-inch underground conduit. In the future, these data wires will connect to different sensors, providing such data collection as array cell temperature, wind direction and speed, as well as individual array current.

Each set of 18 panels is mounted on a dual-axis solar tracking mount. Dual-axis means the mount will track the sun

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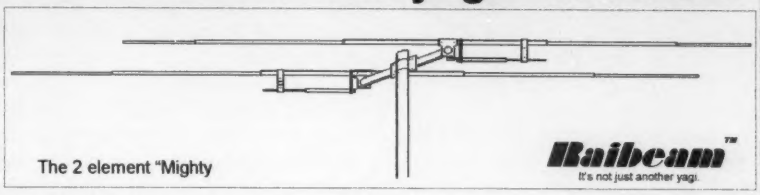

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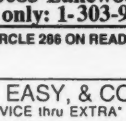

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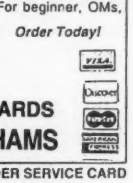

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from east to west and north to south, all at the same time. At dusk, the "trackers" automatically reset back to the east, awaiting the sun's return the next morning. Each tracker is driven by two small electric motors.

A small battery operates the motors at night so the array is pointing toward the east.

Controlling the Power

Under a bright, clear sky the three arrays will produce over 118 amps continuously. Peak current has been noted at over 125 amps. A Heliotrope General CC-120E was used to control the current to protect the batteries.

This controller is state-of-the art in power MOSFET design. Using PWM (pulse width modulation), the power MOSFETs keep the battery bank from being damaged by overcharging. Although the CC-120E is specified for 120 amps, the first unit did not survive. After consulting with Heliotrope General, we decided to add additional heat sinking to the controller. This heat sink consists of a half-inch thick aluminum plate about four feet square. In addition to the aluminum plate, several sections of a large extruded heat sink were also attached to the plate.

The CC-120E has an internal cooling fan controlled by the temperature of the blocking diodes. The fan will run when the case temperature reaches 100°F. At no time has the automatic thermal shutdown stopped the CC-120E.

Battery Storage

We used good ol' lead-acid batteries, wired in a 24-volt system. The bank consists of 24 6V golf-cart batteries. Each battery has a capacity of 220 amp/hrs, so the battery storage bank has the capacity of 1320 amp/hrs at a 20-hour rate of discharge.

Loads

A Trace 2420 sine wave inverter supplies AC to all of the loads. So far, there has not been any load that the Trace has not been able to handle. This includes a deep well pump and various refrigeration units. The Trace has an internal DC charger, but this feature is not being used. With automatic shutdown from everything from a low battery to an overtemp condition, the Trace has been working without a glitch since day one. It has also managed to survive several very close lightning strikes, when it would shut down, wait a few minutes and then restart.

The Trace inverter, at the time the system was being designed, was available only for 24 volts. It is now available for 48 volts. Had that unit been on the market, I would have chosen it, which would have reduced the cost of the welding cable used to bring in the power from the arrays.

System performance

The system has been online for over a year and has produced over 4 *million* kW hours.

Two of the dual-axis trackers failed, but they were replaced by the manufacturer. Since the replacements were installed we haven't noted any problems with the trackers.

With the dual-axis trackers, in the summer months the array-to-load ratio is over 10:1. This means there is slightly more than twice the array capacity than load demand. The battery bank can be depleted to 50 percent at night and be fully recharged by the middle of the next day.

During the winter months, the array-to-load ratio is a break-even 1:1. The battery storage is sized a bit too small to operate all the loads during the winter. Increasing the battery size would provide greater running time, but it would also increase the time required to fully recharge. In the summer, Ohio averages over seven hours of sun per day when using the dual-axis trackers. However, in January we average only three hours.

Things I Would Change

My original design did not specify the dual-axis trackers. I had specified a seasonal adjustable top-of-pole mount. In this location of Ohio, the trackers will not produce much additional power during the worst part of the year.

In January, the sun sits too low in the south for the trackers to do much good, but Chuck had to have them.

I had originally specified Trojan L-16 batteries for the battery bank. Chuck decided against them from two reasons. First, new 6-volt lead/acid golf-cart batteries were available for $38 each from a local source. The L-16s, on the other hand, were $190 each. The L-16 is also 6 volts.

The golf-cart battery weighs about 70 pounds. The L-16 is 120 pounds. Since the batteries are in the basement, each battery would have had to be carried down by hand. Of course, when a battery went bad, it would have to be carried up as well.

Why not use a different battery? Well, ideally, a forklift battery would have been my first choice. The problem is, you need a forklift to move one! We considered NiCd batteries, but their cost put them out of the question. When the current batteries need replacing, we may use large 2-volt sealed lead-acid batteries.

The Bottom Line

What is the payback period? Well, the whole system cost about $35,000. Had Chuck gone with the top-of-pole mount instead of the dual trackers, he would have saved $7,500. And using L-16s instead of the golf-cart batteries would have cost him about $2,000 more.

As for the payback period? Well, Chuck will more than likely never see the system pay for itself. However, several months after the first array went online, Chuck's electric bill dropped so much Ohio Edison sent out a troubleshooting crew.

Still, not counting any maintenance of battery replacements, Chuck is looking at around 15 years before he breaks even.

Caveats

Electrical space heating and refrigeration are two loads that should be run on a source of energy besides PV. In this case, Chuck is running both air

Continued on page 83

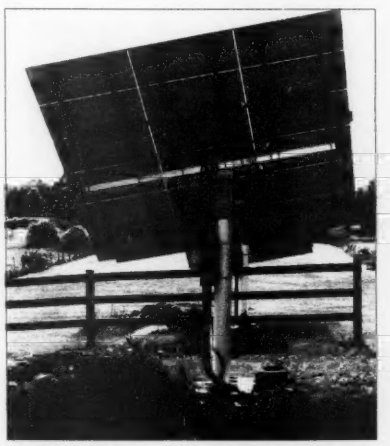

***Photo B.** The array is supported by an 8" pipe which is seated in five feet of concrete.*

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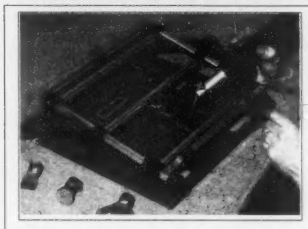


Leister/Malcom

Leister sells hot air equipment for welding, drying, curing, shrinking, desoldering, and soldering. The leaflet includes color photos of the new Leister Hot-Jet "S", and is available from The Malcom Company. To find out more, circle Reader Service No. 201

"World Class" Relays

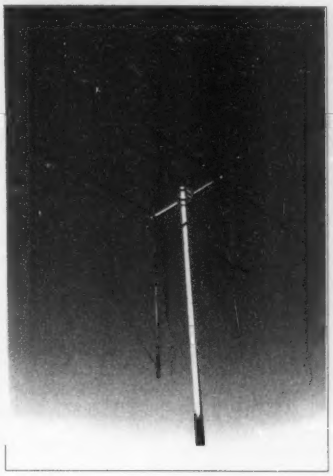
GEM Electronics, Inc.

Need a Data Sheet on a particular relay, or some general information on relays? GEM Electronics can help you with their line of Meder Electronic Relays. Circle Reader Service No. 203.

Active Filter Cookbook

Microcomputer guru Don Lancaster has been at it again with this 17th edition. So what's an active filter? It's a combo of op-amps, resistors, and capacitors which replace traditional bandpass and high-pass filters with something smaller, less expensive, easier tuning, and simple in design. The book runs 240 pages and is packed with enough application circuits to keep a builder happy for months. It's $28.50 via better book stores or from Synergetics Press, Box 809G, Thatcher AZ 85552. Circle Reader Service No. 208.

Cubex Antenna Company



The CUBEX Antenna Company has produced the "BUMBLEBEE" 6m 2-element quad antenna. It is all fiberglass with a heavy duty aluminum mast to boom coupler. The antenna is fed directly with 52-ohm coax and features the exclusive CUBEX tuning block that allows the antenna resonance point to be adjusted so that the entire 6m band can be used without completely changing the wire elements. The antenna comes with the driven element pre-marked for a resonant frequency of 50.4 MHz, giving the antenna a bandwidth of 1.5 MHz at an SWR of less than 1.7 to 1. The antenna can be rotated for horizontal or vertical polarization, and has a boom length of 27 inches. The best feature is the price of $69.95 F.O.B. BREA CA, PLUS $12 S & H. Circle Reader Service No. 202.

NCG COMET

The COMET "Quick-Disconnect" Mobile Antenna Mount, Model CQ-5M consists of two separate sections: A trunk-mount base that is attached to the trunk edge with four set screws, and an antenna-mount base that fits inside the trunk-mount base. Sliding a lever wedges the antenna-mount base securely in place. To remove the antenna, simply slide the lever to unlock. The antenna can then be placed inside the trunk. Comet's 17-foot deluxe coax cable assembly is included. The first 12 inches of coax is RG-188A/U style, allowing easy entry into the trunk without causing cable damage or starting a water leak. The coax balance is double shielded, low loss, with gold-plated connectors.

Two offset washers rotate around the antenna connector to adjust the antenna to the vertical position. The bottom of the trunk mount base is rubber-coated to prevent paint damage. It has a wide foot print to support large antennas. Two versions are available: CQ-5M has an SO-239 antenna connector, and a PL-259 transceiver connector. CQ-5N has N-type connectors. Contact your local or favorite amateur dealer. List price is $66.95. For more info on COMET products, and a complete catalog, contact the NCG Company at (800) 962-2611, or circle Reader Service No. 204.

MCM Electronics

MCM Electronics, an industry leader in the distribution of consumer electronic repair parts and accessories, is introducing their *free* catalog, No. 36.

The catalog contains over 2,700 new items, including project accessories, semiconductors, connectors, test equipment, computer products, audio, TV, VCR, and appliance repair parts. This catalog also introduces LAN cable test products from Paladin and Triplett, quality crimping tools from Sargent, and many other new items for the electronics service technician. Catalog 36 also announces permanent price reductions on semiconductors, video heads, flybacks, motors, and other items used in consumer electronics service. Circle Reader Service No. 207.

Dynamic Electronics Inc.

Dynamic Electronics Inc. is pleased to announce a new Morse Code Computer Interface that allows sending and receiving the International Morse Code with an IBM-compatible computer. The interface electronics is contained in a DB-25 housing which can be connected to any COM port on an IBM Compatible Computer. An adapter can be used for 9-pin COM ports. A 1/4" plug is included for the "phone" jack and a 1/4" stereo plug is included for the "key" jack of a transceiver. A stereo-mono adapter (not included) can be used for 1/4" mono "key" jacks. A 900-Hz audio filter with a noise subtracter is included. An RCA-type phono jack is available for connecting the processed CW to the high impedance input of an audio amplifier. The speed is automatically tracked on receive. The code is converted to ASCII characters and displayed on the screen. The station can be left unattended and messages can be saved to a disk file when a call sign match is received. A Call Alert feature will allow the computer to sound an alarm when a call sign match is received.

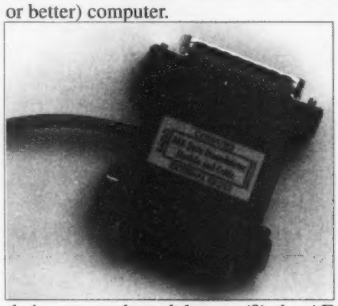
Transmit features include a type-ahead keyboard buffer, and the options of sending from any of the 8 preprogrammed messages, or from a disk file. The transmit speed can be varied from 5 to 100 wpm. A message can be automatically sent at a future time without the operator being present.

Software is supplied on both 5.25" and 3.5" diskettes. The cost is only $79.95 plus $3 shipping. Payment can be made by checks, VISA, or Master Card. For more information, circle Reader Service No. 206.

Advanced Electronic Applications, Inc.

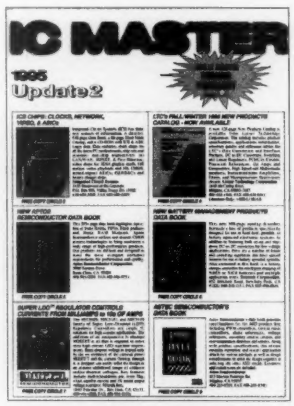
AEA recently introduced the new AEA ACARS package for receiving aircraft digital communications. AEA ACARS is a package containing a small demodulator cable and DOS computer software that, when attached to a scanner or receiver, lets you decode the digital communications taking place between ground stations and aircraft. ACARS is a digital data link system designed to enhance air-ground-air communications. If you are near a major airport, you can even monitor both air-to-ground and ground-to-air digital communications.

All you need is AEA ACARS, a VHF receiver or scanner capable of covering 129-132 MHz AM, and an IBM-compatible (386 or better) computer.



There are three versions of AEA ACARS: (1) the entire package which includes the demodulator, software, and detailed manual; (2) the AEA FAX ACARS Upgrade—so AEA FAX owners can get the software-only version of AEA ACARS to use with their current demodulator; (3) the AEA ACARS 900 package. AEA PK-900 owners already have the hardware built into their data controllers. All they need is this special software-only version of ACARS designed to work with the PK-900. AEA ACARS is available from your favorite amateur radio equipment dealers. For more information on AEA ACARS, call AEA's literature request line at (800) 432-8873, or fax requests to (206) 775-2340. Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood WA 98036. Or circle Reader Service No. 205.

IC Master



The new IC Master Catalog is coming out in February on paper, and on CD in March. With over 120,000 different *kinds* of integrated circuits sold by way more than 250 manufacturers around the world, you need something to help you stay oriented. IC Master is a comprehensive reference full of product information. The CD comes in DOS and Windows versions (sorry, Mac users). The Windows version even includes packaging and pin-out information.

The new catalog will have info on more than 20,000 first-time-listed devices, including over 460 new op-amps, 6,000 new listings for memory, 2,000 new digital, and 500 new processors/controllers.

As valuable as the above information is, you can also order several smaller catalogs and other literature from manufacturers for free from IC Master, such as the Datel DC/DC Converters Catalog, the Astec Semiconductor's Data Book, and the Semtech Battery Power Management Products Catalog.

Order before the January 31st deadline and you can get the 1996 IC Master CD-ROM PLUS for $210, which is $25 off the reduced regular subscription price. Circle Reader Service No. 209.

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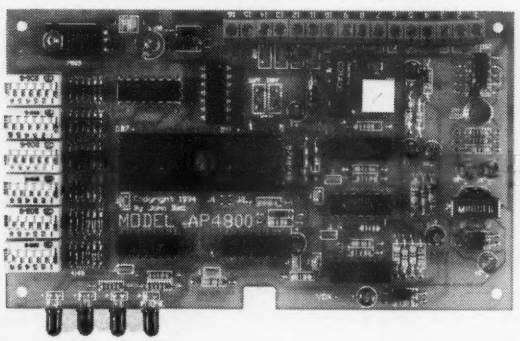

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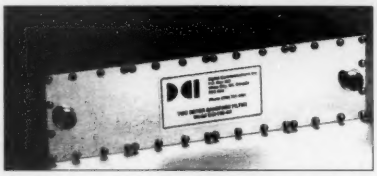


Photo A. The DCI-146-4H 2 meter bandpass filter.

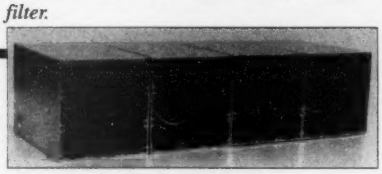


Photo B. The interior of the unit.

Bill Clarke WA4BLC
764 Alta-Voor Road
Altamont, NY 12009

With the proliferation of radio signal producers, both those that are supposed to radiate signals and those that do anyway, 2 meters has become a chore to listen to in many RF-dense areas.

An RF-dense area can be a metropolitan area with loads of pagers, commercial repeater services, cable TV, and/or computers. It can also be a rural mountain, loaded with broadcasters and leased repeater services.

Types of Interference

Nearly everyone using 2 meters has experienced some form of interference at one time or another. Generally, the interference experienced will consist of:

Signal suppressing or blocking—caused by a strong RF signal which desensitizes the receiver, making it incapable of receiving the desired signal. Such signals are from transmitters on "near the 2 meter band" frequencies. A good example is the large number of paging systems located just above the two meter band.

Sidelobe interference—occurs when a signal on a nearby frequency (not within the receiver's passband) bleeds into the region of the passband and blocks the receiver.

Intermodulation—usually referred to as intermod or IMD, is caused by two or more signals from outside the receiver's passband mixing internally within the receiver, then blocking or otherwise interfering with the receiver's operation.

Using a filter such as the DCI-146-4H can reduce instances of these types of interference, often totally eliminating them.

The DCI-146-4H filter consists of four helical resonators mounted in a very solid chassis with two coaxial cable connectors. Helical resonators can be thought of as very high-Q RF circuits, passing only a very narrow band of signals. In the case of this particular unit, that passband range is 144 to 148 MHz. The skirts are quite steep, as shown in the chart, and provide up to -62 dBm reduction in signals outside of the filter's passband. The DCI filter is passive and requires no outside power source. You receive and transmit through it with power levels up to 200 watts.

This type of filter (very narrow passband) allows the receiver to be undisturbed by most out-of-band signals, providing for increased sensitivity and clearer reception.

Specifications

Passband:	144 to 148 MHz
Passband loss:	<1 dB
Selectivity:	-62 dB at 136 MHz
	-50 dB at 156 MHz
Power rating:	200 watts
VSWR:	1.5:1
Dimensions:	12 x 3 x 5 inches
Weight:	2 lbs. 11 oz.

The Test

To give the DCI 2 Meter Bandpass Filter a real-world operational test, I took the unit to a nearby mountaintop where there is an abundance of commercial FM and TV broadcast transmitters and various commercial repeater systems (on all bands). In this particular area, the S-meter (which is an LED bar graph on my 2 meter transceiver) dances all over, and, although the squelch is not broken at all times, the receiver is quite desensed. Even relatively strong stations cannot be heard well.

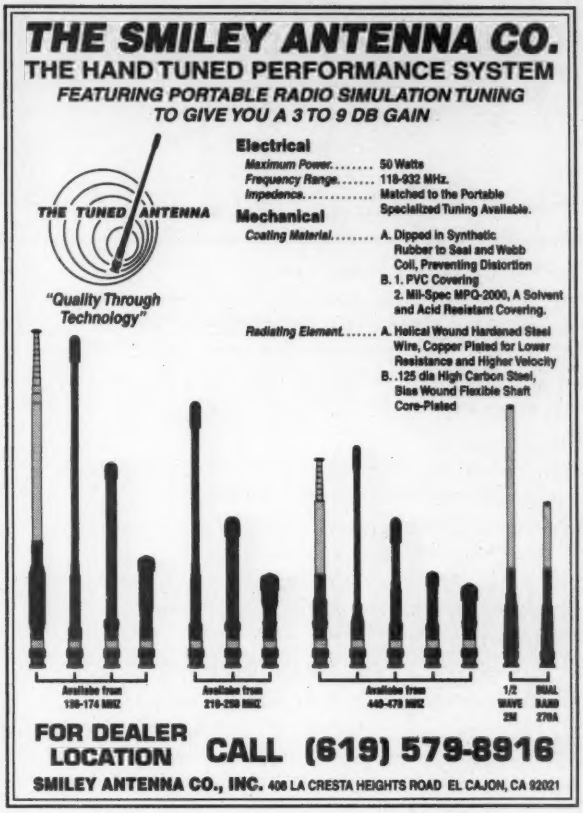
The test results on the mountain were quite positive. Only the slightest indication of intruding signals on the S-meter could be seen, and that was very sporadic. No noticeable degradation of signals was noticed, even when working distant repeaters and weak simplex stations. A quick removal of the filter gave instant proof that the filter really works, as without the filter the S-meter came alive and the distant stations were lost.

On the test bench I found that the unit's passband was a very close approximation to that indicated in the manufacturer's literature. Due to the very steep skirts of the DCI-146-4H, I doubt CAP and MARS users could use the filter. The SWR seen during transmit rises very quickly as you move out of band. During static testing I used a commercial dummy load and input power of 50 watts, although the filter is rated at 200 watts. Of note: No heating of the filter was observed during testing.

As a final operational test, I went near the transmitter site of a paging company that operates just above the 2 meter band. Using an HT connected to my mobile 2 meter antenna, I found the receiver to be blocked a large percentage of the time and the S-meter dancing a jig. I connected the DCI-146-4H into the antenna line and the problem ceased, with only a small amount of S-meter jumping noted. This type of setup should help the commuting ham using a handheld in RF crowded areas.

Comments

Installation is simple: Just put the DCI-146-4H in the antenna line by using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a short jumper cable. The filter will do its job without any operator control—install and forget. Due to its size, you might wish to remotely mount the filter—just keep in mind that you want a reasonably short patch line from the rig to the filter. Firewall mounting appears to be practical on some vehicles (where there is space). Other choices are under a seat, in the trunk, etc. There are no mounting holes on the unit, and *do not drill any!* My recommendation for mounting is:

1. Use plumber's strap over the unit and fasten the strap to the mounting surface with sheet metal screws.

2. Attach the unit to a surface with silicon glue.

The DCI 2 meter filter makes up for the wide-open front ends found on most 2 meter transceivers (wide-open meaning the receivers easily receive 135 through 170 MHz). When using the DCI-146-4H, effective receiver sensitivity outside the 2 meter band will be greatly reduced.

Too bad someone cannot design a filter that will remove all the computer hash heard around shopping centers, bands, and the like.

Availability

The DCI line of helical resonator filters is available at most ham radio stores and from DCI Digital Communications, Inc.

Note that DCI Digital Communications also produces filters for the 220 and 440 amateur bands. Commercial filters areavailable—call for specific applications.

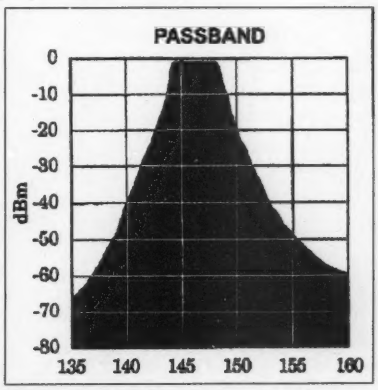

Fig. 1. Graph of the unit's passband.

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Deadlines

In order to have time to return tickets to you, we must have advanced registration orders postmarked not later than May 3 (USA) or April 26 (Canada). Tickets will not be mailed before January 15th,1996. Ticket requests that are received **AFTER** the deadline will be processed and **HELD** for pick-up at the Hamvention Office in the Silver Arena. Tickets can be picked up beginning Thursday, May 16 at 8:00 a.m.

Flea Market

Flea Market Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. A maximum of 3 spaces per person (non-transferable). Electricity is available in a portion of the last Flea Market row for $50 additional. Rental tables and chairs are not available in the Flea Market. Vendors ***MUST*** order an admission ticket for each person when ordering Flea Market spaces. Please send a separate check for Flea Market space(s) and admission ticket(s). Spaces will be allocated by the Hamvention committee from orders mailed by February 5. Please use 1st class mail *only*.

Notification of Flea Market space assignment will be mailed on or about **March 25, 1996**. Please indicate in the box below if you would like to attend regardless of Flea Market space assignment.

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by Dean Lewis WA3WGV

Oak Hills OHR-400 4 Band QRP Kit

Ah! the joys of building!

Jeff M. Gold AC4HF
1751 Dry Creek Road
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I had not built a kit in awhile and my personality had started to deteriorate proportionally. I seemed to have forgotten how therapeutic the building process is for me. I started to rationalize that I have built one of everything and that placing components on a board was just not as much fun as it used to be. I couldn't resist the temptation when I heard about the Oak Hills fourbander. Four bands, three of my favorite (20, 30, 40 meters) and one that I need to spend some more time on (80 meters) anyway. So I told the XYL I needed some money for counseling, and sent off for the kit.

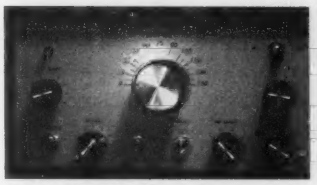
I anxiously awaited the arrival of the kit. My children are now pretty well grown up, no grandchildren in the near future, so I guess this is the closest I can come for the time being to an anxiously awaited arrival. I got home from work on Friday afternoon. This was a real big weekend for me. Three days off and the weather was supposed to be nice for the first time in eight weeks. What more could I ask for? I came home from work and there was the box from UPS that I had been waiting for. Having significantly matured (if you can believe this one), I went and changed out of my work clothes before taking the prize to my workshop to unpack.

The first thing I noticed when opening the box was how carefully and professionally it was packed. All of the little components were packed inside the case and sealed so that you don't accidentally throw them away. There are three printed circuit boards, not counting the optional keyer. The boards are the absolute best I have ever come across (I have seen some as good, but none better). They are solder masked and have a terrific silk-screening. There is *no* question which parts go where. The receiver board has the parts fairly well packed, so the very high quality silk-screening is a definite plus.

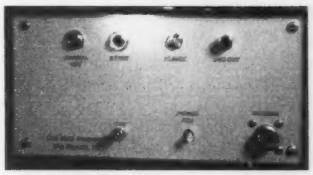
Another thing I have noted is that Dick from Oak Hills really listens to his customers. This is evident with the documentation. The documentation comes in several sections which are individually stapled. The printing is top quality and easy for even my old eyes to read without the need for those new reading glasses (so in essence the kit makes me feel a little younger). The first section of the documentation is the Assembly Instructions. Oak Hills has a couple of pages on things you need to be aware of to make your building experience more pleasant and more likely to have you succeed with the project. The instructions are step by step, but not in the hand-holding "put this part R3 in hole in section 1A" way Heath used to do it. I really appreciate the clearness of instructions and not having to read and reread something many times to figure out if what I read and thought I understood is what the writer meant for me to understand.

Working with technical writing in the computer field, I realize how hard it is to write good instructions. Oak Hills also has started to include very professional diagrams for the final assembly in with the documentation. There are separate sections for each board that list all the components, a schematic, and an excellent, enlarged overlay. One of my main criteria for pleasure in building a kit is knowing what the author really means when building instructions are given. I feel it takes some of the therapeutic value away from the project when there is ambiguity in any of the steps.

The parts for each board come separately wrapped. This is another example of Oak Hills' listening to the customers.



Front OHR-400



Back OHR-400

For each board the parts are separated by type, such as resistors and capacitors. I usually hate the first stage of building, which involves the sorting out of the parts and checking to make sure that they are all there. It used to take a great deal of time to separate and label the parts. Now I use little plastic parts bins and dump the resistors in one, the capacitors in another, and so on. I find it fairly easy to then use my magnifying glass (even Oak Hills couldn't solve this problem for me) to make sure I get the right part when I start stuffing the board. I find that after a few minutes of separating out the parts and documentation I can get into the project fairly quickly.

The cabinet for the kit is also very high quality and has a great paint job. The panels are beautifully screened. I believe them to be as good in quality as the major transceiver manufacturers' cabinets.

There are two distinct and equally important aspects of a kit for me: how much fun it is to build and how much I like to operate it when it is done. I have found that there are sufficient variables involved in implementing a kit design so that even the best designs may not work as they should when they are built. Some rigs are just more fun to operate than others. I finally took some time recently to ponder this aspect of my building experiences. I have built about every kit on the market in the last three years. I can pinpoint exactly what constitutes a pleasurable building experience for me. The parts in the kit have to be high quality;

the documentation has to be clear, tested and revised to eliminate errors, with no ambiguity at all; the printed circuit board needs to be high quality and clearly screened; and there should be separate parts lists by circuit board, with a clear enlarged parts overlay.

The fun-to-operate part is much more nebulous. This aspect is very personal. I have come up with a scientific method to determine this aspect. It is really quite easy. I have many rigs on my workbench. The number and type seem to change constantly. I find there are some rigs that I just keep using after the initial testing and evaluating. The reason for this is that they seem to me to work better and are more fun to operate. I put my Norcal 40 in this category, as well as the Oak Hills kits I have built. I think it is pretty amazing that small companies like Wilderness Radio and Oak Hills can put out such high-quality kits. They work very well as long as they are assembled properly.

Building

I found no unwanted surprises while building the kit. I built up the three boards and put in the optional iambic keyer. All went together quickly, even though I checked my work very carefully to make sure the correct parts were in the proper places on the printed circuit board and also checked all of my soldering joints with a magnifying glass. It can take quite a few hours to trace problems such as diodes or electrolytic capacitors being put in the wrong direction, or having the wrong values of resistors or capacitors placed on the board. It is much more economical and pleasurable to take a few extra seconds for each part and verify that they do indeed belong at a particular location. The board was a pleasure to solder. The plated through-holes are very easy to solder and make for strong connections. These also complicate unsoldering, so make sure you have the right parts in the right holes! If you should make a mistake (most of us do), I recommend a good quality solder sucker (can be purchased at Radio Shack) and with this board some solder wick is helpful.

Testing and Alignment

It was another Friday evening and the end of a really tough week. I am supposed to take my wife out for dinner, and my son is already at a friend's house for the weekend. Sounds like a good time for a romantic weekend...well, there was one problem. I was super-stressed from the week's events. I was in dire need of a "therapy session."

I did my mandatory chores, changed to my "play clothes" and went into the shack. I went to the bench and checked the Oak Hills Research 400 that I have put hundreds of parts into and over 50 wire connections and mounted many mechanical connectors, switches, and jacks.

The project passed the initial smoke test. I was very relieved when nothing sizzled on power up. I then took out the alignment procedures and was ready to roll. If you don't have the proper equipment or can't get it aligned, Oak Hills will align the completed rig for $65, including shipping it back to you.

The initial frequency setup went very quickly. Three of the four bands came up exactly on frequency with no adjustments necessary. Getting the fourth on frequency was a matter of adjusting a trim capacitor. It was very easy, using a frequency counter as is suggested. I switched back and forth between the bands and the oscillator for each band started with no problems. The only time-consuming adjustment involves adjusting a coil and a trim capacitor to get the correct bandwidth out of the VFO. I also like to get it so the dial reads near the real frequency. I didn't encounter any difficulties with this part.

You next adjust two coils on the oscillator board for each band for peak signal voltage as measured on a scope. I later found that I did not tune the 20 meter band coils correctly. I noticed this when I tested out the rig and found the SWR was high on 20 meters, even though I knew I was using a resonant antenna. There were two peaks for the coils, using a scope to monitor. You need to check to make sure you peak them on the correct frequency, as stated in the manual. On 20 meters I noticed that when I was peaking on the wrong frequency the power output went up to about 10 watts on my QRP wattmeter, but was right in range at the designated frequency.

Your next step is to move to the receiver board and adjust the voltage at a given point using a trimpot. That is all you do on that board at this time.

Moving on to the TX/REC board, you tune a set of coils for each band to get maximum signal output as measured on a QRP wattmeter. The two coils interact so that you need to go back and forth a few times. I noticed that 20 meters wasn't putting out a full 4–5 watts. I found that I had the power supply turned back to about 9 volts. I turned the supply up to 13 volts and the power came right up. All the bands tuned up easily and I got the correct power output on each band.

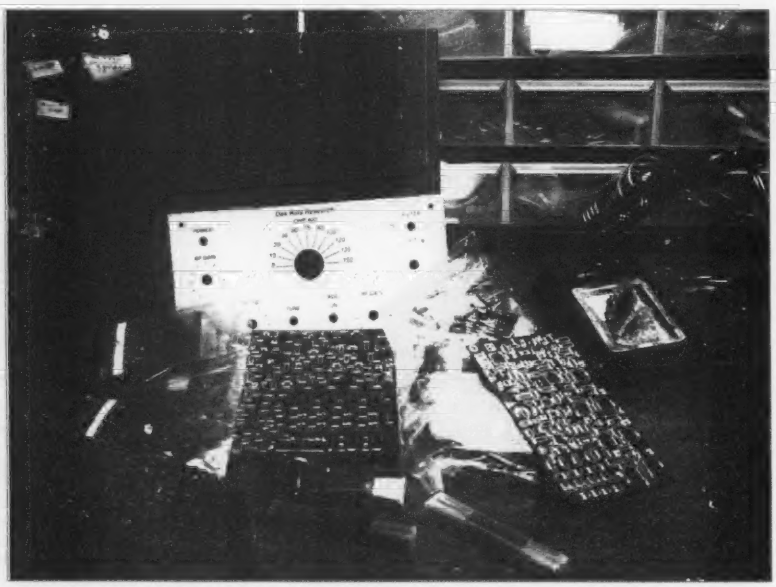


***Photo A.** The OHR-400 QRP kit is sensibly packaged and logically arranged.*

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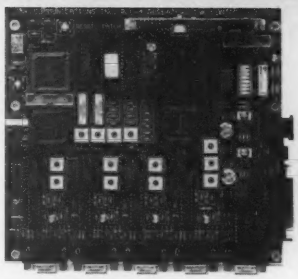

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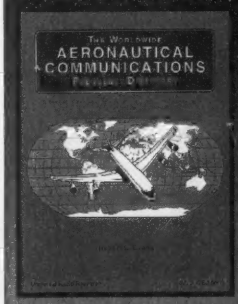

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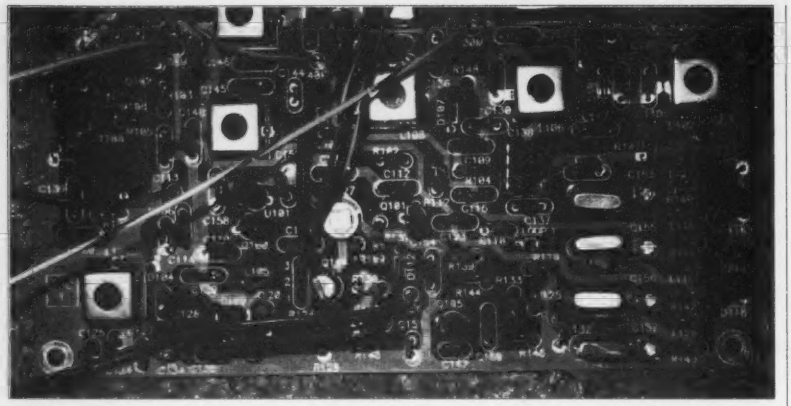

Photo B. *"The boards are the absolute best I have ever come across. There is* no *question which parts go where."*

The rest of the alignment went fairly quickly (well, I actually missed dinner and was in the doghouse for a while, but it seemed like only a few seconds). You adjust a trim capacitor on the receiver board to get the signal centered in the right place for the audio filter. The directions are quite clear and should be followed carefully. You then only need to adjust the sidetone level and one more trim capacitor to make sure that you are transmitting and receiving on the same frequency. Another transceiver is a good tool for this. If you have installed the optional keyer there is a simple adjustment for the iambic keyer weighting to get it to your preferred setting.

"I would recommend this kit very highly to hams that have a building project or two under their belt . . . "

To finish fine-tuning the receiver I decided to take it to my operating bench and hook up an antenna. I put the rig on 20 meters using a gel cell for power. As I was connecting the antenna I heard EA3DKR calling CQ. I finished connecting the antenna quickly and gave him a call. Carlos came right back to me. Who needs all those other alignments? He was a 559 and gave me a 559. My two-element quad may have helped a little. I worked an LZ1KOZ through a pileup almost immediately after working Carlos. Next I switched to 40 meters and had a long rag-chew, then back to 20 to work some more DX. I worked a Cuban station off the back of the beam.

Later in the weekend I worked UX3FW, Yura, S59AA, in Izmail, Franc SP3WYQ, George T77BL in the Republic of San Marino (it took awhile to figure out where that was), and Franc 9A2HF. I also did some rag-chewing on 30, 40, and, yes, 80. One QSO on 80 meters was an hour long. I hadn't worked 80 in quite awhile and was very pleased with how well the rig worked with 5 watts on this noisy band.

I received comments like "Your new rig sounds great," "Did you say QRP?," "Congratulations, QRP, sounds FB, Jeff!" (this guy started at 100 watts and we ended up going QRP–QRP on 80 meters), "solid copy." The last guy I talked with went on and on about how good it sounds. I worked anyone I heard, even DX that was real weak. I had nice long QSOs with no problem, on every band.

The rig was putting out about 4 watts on 20 meters and I turned the power back to 4 watts when using the other bands. Listening to the OHR-400 on a commercial transceiver, I found it had a really sweet note.

I noticed on 20 meters the SWR was just a little higher than it should be. I took out the alignment tool that was provided and adjusted the oscillator board coils for 20 meters. It brought the SWR right down to 1:1 and the rig was putting out 4 watts as it was supposed to.

I had the covers off a number of times during the weekend. This is standard operating procedure for me. It usually takes me a few times to get things set up the way I like them. I guess you could say I am a "tweak freak."

The receiver is sensitive and selective and quiet. The VFO is very stable. The audio filter and RIT work well. The QSK is fantastic, very quiet and quick. The optional Curtis keyer works fine. The audio is enough to drive a nice size Radio Shack speaker. The transmitter has a variable power control so you can work very low power if you choose to. You can adjust the power from about 5 watts on 20 and 30 to about 8 watts on 40 and 80 to close to zero.

I must say that I really enjoy operating this little rig. There is an intangible variable that I have with both the building and the operating of one of these kits. I call it the enjoyment factor. The building of this gets my top rating. A great deal of time and energy went into making it a very pleasurable experience. Does this mean it is perfect? By no means. I could spend time criticizing minor aspects, but they were minor enough that they in no way detracted from the building experience or my operating experiences. I would recommend this kit very highly to hams who have a building project or two under their belt, or even to a new builder who may want to get a little help with the alignment. There is great pleasure and satisfaction to be had when using a rig that you built yourself and that works very well. 73

Specifications: 80-40-30-20 Meter Bands

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Kill Your Interference

Steve Katz WB2WIK/6
21101 Celtic Street
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This subject has been so well covered over the years that I can't adequately bibliograph past articles. Yet, I still hear a dozen times a week from hams, both old and new, that they can't operate various bands (or at various times, or whatever) because they cause interference to televisions, radios, telephones, intercoms, compute modems, fax machines...you name it.

Hey, folks, this is 1996. We're all part of the information superhighway, like it or not. Electronic trinkets abound, and thousands more will follow. Who doesn't have a PC? Who doesn't have a fax machine? Who doesn't have a stereo system? And surely, who doesn't have a telephone?

In many parts of the country, cable TV servers and telephone companies are cooperating to replace copper wiring with fiber-optic cables to create interactive television and telephone services with fantastic bandwidth. These services will be more difficult to interfere with, because you can't create electromagnetic interference to an optical transmission system. But it might be many years before our homes are suitably cabled, and we'll still be using conductor-type appliances for the foreseeable future.

The solutions are amazingly simple. But many hams don't seem to want to know, or do, anything, to help themselves. If you're not a total dimwit, follow some simple advice: Interference problems can be resolved, and it's up to you to resolve them.

TVI

This is a relatively easy one. Television sets are intended to be receivers, they're just not particularly selective ones. If you and your neighbors are on "cable," and you're having TVI problems in your own home or those of your neighbors, the first order of business is to reduce the number of peripheral wires connected in the cable signal line. If you (or your neighbors) have appliances other than an approved cable TV converter box or a TV set connected, disconnect everything else (VCRs, preamps, switches, etc.) and see if the TVI persists.

The coaxial line from the cable service to the television set should be as direct as possible. Don't connect VCRs in this path! If you need to use a VCR, as most of us do, connect its input/output ports using audio cables to the television's audio input/video input and audio output/video output jacks. All the modern sets have such provisions. I see many licensed hams who have VCRs and other accessories connected to their cable lines, when it is completely unnecessary. Why convert audio and video signals to Channel 3 and feed them into the TV's tuner when you'll get far better results just plugging them directly into the audio and video amplifiers in the set, without using any RF? It doesn't make sense.

If you're on cable, do *not* use a preamp. They're a total waste of time for cable television services. The signal level from the cable should be sufficient to provide a good, strong signal to four, five, or six televisions without the need for any kind of preamplification. If you think you get "better reception" with a preamp in your cable line, either you're kidding yourself, or there's something seriously wrong with the signal level provided by your cable company. Ask them to come out and perform a measurement on your cable signal level. They all have small, hand-held devices which let them know immediately if your signal level is sufficient. If it isn't, then it is their responsibility to fix the problem, not yours.

Another warning if you're on cable: If your cable was installed more than a few years ago, it is very likely the service has deteriorated due to lack of adequate maintenance. The coaxial cables used need to be replaced every few years. They don't last forever. The connectors are not waterproof, and often fill up with water, creating a reduction in signal strength and the possibility of mixing signals with your transmitter, which in turn creates interference. Connectors should be clean and dry. You can check them yourself, if you can reach them. If you disconnect the cable from the "feed" (either above or underground), and water drips from the connector, this is a real problem that needs to be addressed. Water in an RF connector almost always indicates that water will also be present in the coaxial cable attached to it. This, too, adds attenuation and reduces signal levels. Normally, maintenance of the cable right up to the entry point of your home is your cable company's responsibility. The cable inside your home is normally your responsibility.

If you or your neighbors are not on cable, you may not have sufficient signal levels to override interference. Unless you can literally see the television transmitter's antenna from your TV antenna site, the signal will not be all that strong. Replace old, oxidized antennas with new ones, and make sure they are properly aimed. Avoid using 300-ohm "twin lead" for TV antennas! Use a 300-ohm-to-75-ohm balun instead, installed directly across the antenna terminals, and feed the antenna with high-quality, double-shielded RG59- or RG6-type CATV coaxial cable. (RG6 "quad," which has *four* shields and is "100% shielded" is an excellent choice. It's what the cable TV companies use, and it's not expensive.) If you don't have the proper crimping tool for type "F" TV connector installation, borrow or buy one. The best ones are not expensive, and are a good investment, since it seems these connectors are here to stay. If your TVI problems are from HF

(1.8-30 MHz) transmissions, try using a high-pass filter in the coaxial line to your television set, with the filter installed right at the rear panel connector of the TV, or better still, *inside* the TV between the rear panel and the tuner. Try grounding the case of this filter. If that doesn't help or makes the interference worse, remove the ground.

A word about high-pass TVI filters: These come in several "flavors," and performance is unrelated to cost in my experience. The most effective ones are really the 300-ohm "twin lead" filters, where each side of the balanced line is filtered. Unfortunately, the most effective TV transmission line is coaxial cable, not twin lead. Herein lies a dilemma, but it's an easily solved one. For stubborn cases of TVI, I've often found that using a coaxial feedline to the back of the set, followed by a 75-ohm (coax)-to-300-ohm (twin lead) balun, followed by a 300-ohm high-pass filter, followed by another 300-ohm (twin lead)-to-75-ohm (coax) balun, into the TV set's tuner, is what works best. Sure, it seems crazy to transform from coax to twin lead and then from twin lead back to coax again just to install a 300-ohm filter, but there is a method to this madness.

The problem with most 75-ohm coaxial cable high-pass filters is that while they do a splendid job rejecting interference conducted within the cable, they do absolutely zero for "common-mode" interference, which is carried on the outer conductor of the coaxial cable. Such interference conducts right past a 75-ohm coaxial filter, and enters the television set on the outer conductor (shield) of the cable alone, and can create nightmarish problems. By breaking up the cable's shield using isolation transformers and a balanced filter, such common-mode interference is thwarted by the "broken circuit" created. (P.S.—Good 75-ohm-to-300-ohm baluns, and 300-ohm high-pass filters, have almost no insertion loss, so don't worry about losing a lot of signal strength with this system. If you use good coaxial cable and a good 300-ohm filter, it won't happen.)

If the interference problems are from VHF-UHF transmissions, the best high-pass filter in the world won't help. You'll need to use a "stub," which is tuned to reject the specific frequency of the interfering signal. Such a "stub" will need to be one quarter-wavelength long, measured *in coax*, at the interfering frequency, and connected in parallel with the coaxial feedline to your TV set's tuner, as close to the tuner as possible. One quarter-wavelength *in coax* will be shorter than a real quarter-wavelength because the length needs to be corrected by the *velocity factor* of the coax used. For solid-polyethylene coaxial cable types, the velocity factor is usually 0.66; for "foam" dielectric coaxial cable types, the velocity factor is higher, typically 0.78 to 0.80 or so. Such a "stub" is easily connected to the backside of a television receiver using a "T" (or "tee") adapter having a single type F male fitting and two type F female receptacles. Such items can be picked up for a couple of dollars at Radio Shack or similar retail stores. By the way, in case you didn't know, a quarter-wave "stub" rejection filter has *no connection* to the "open end" of the coax. Don't short-circuit the open end, and don't terminate it with anything, or it will be completely ineffective. The quarter-wave "stub" works on the principle that the impedance of a transmission line is inversely proportional to its termination impedance every quarter-wave. If you leave a quarter-wave stub open-circuited at one end, the reflected impedance will be a short circuit at the opposite end, on the frequency where the stub represents a quarter-wavelength in coaxial cable. Thus, a quarter-wave "open-circuited" stub will look like a short circuit on its resonant frequency, and will shunt interference to ground. It works.

If you try hard enough, TVI is possible to eliminate. I've never seen a situation yet where I couldn't do it. It may take several hours, it may take a few dollars, but it can always be done.

Telephone Interference

This is a broad category that applies to all appliances connected to a telephone line: telephone instruments, computer modems, fax machines, etc.

Telephone interference is rare at VHF-UHF levels, but can be very troublesome at HF. One reason is that VHF-UHF signals are quite well shunted to common by the capacitance of the lines and instruments connected to them, but at HF this isn't the case. Another reason is that wavelengths are so much longer at HF that the near field interfering signals might be as far as a few hundred feet away on HF, while the near field is very short on VHF-UHF. Radiated signals are reduced in intensity by an inverse square law based on the wavelength being used. While 100 feet is very "close" on 80 meters, it is very "far away" on 2 meters.

Many telephone interference problems can be eliminated by terminating unused jacks. Since telephone lines are often "daisy-chained" (connected from jack to jack to jack within the house), any unused jack wiring becomes an antenna which can be an efficient receptor of signals. If you have telephone jacks in your home (or a neighbor's home) which are unterminated (no telephone instrument connected), these can cause problems. The easiest solution is to terminate them, whether a telephone instrument is used there or not, with correct passive terminations. Such terminations provide a 500-ohm terminating impedance (*not* a resistance alone!) across the line, simulating a real telephone-type instrument, and they are available for a couple of dollars from your local phone company or at Radio Shack.

If you've tried this and still have interference problems, try another trick: Go to the point of entry of the telephone line to the house and find the connection box located there. This is often a four-terminal "block" with brass machine screws, flat washers and nuts, where the telephone line from the utility connects to the house telephone wiring. Frequently, you will find unused wires just "floating" (not connected to anything) there. Any and all wires floating at this point (wires just twisted together and not connected to anything) can be grounded, since they're not being used, anyway. Strip the insulation off the unused wires, twist the exposed copper conductors together, and tie them to the nearest ground post, which is likely to be close by, since the telephone utilities usually provide an earth ground inside of or nearby this junction box. By grounding unused conductors in telephone wiring, you can short out some RF current which might be causing interference directly to ground. Also, since telephone wiring is often "twisted" along its route, grounding unused conductors tends to "shield" the entire bundle of wires, which can also help reduce RF interference.

If you try both of the measures outlined above and still have interference

problems, try using single-instrument telephone filters. These are sold by many manufacturers as "aftermarket" fixes, and usually have modular telephone plugs and jacks included. If telephone filters are used, they often work best when installed right at the telephone instrument (or computer modem, or FAX modem, or whatever), as close as possible to the equipment. Don't bother installing a telephone filter at the wall receptacle when a cord will be used between the wall socket and the instrument. It will be much more effective when used right at the telephone (or whatever). Sometimes a filter might be necessary in the handset cord as well. I've even seen situations where one filter did very little to reduce interference, but two or three filters in series at the same point worked perfectly. These filters usually retail for about $10 each and, if they work, are well worth the investment.

If you try all the tricks above and still have telephone interference, take a look at how your antenna transmission line is routed. Is it close to, or in parallel with, your (or your neighbor's) household telephone wiring? If so, move it! Is your HF antenna close to the telephone wiring from a street utility pole to your home? If so, move it! You are free to reroute telephone wiring as required to cure interference problems. You don't need the telephone company's permission. Just be sure that if you do reroute telephone wiring outdoors, use the telephone company's original cable, which is designed to withstand the abuses of mechanical stress and weather. Inside your home, these factors are unimportant and you can pretty much do whatever you want, since you own this wiring, anyway.

If in the process of investigating telephone interference you happen to find frayed, worn, or broken cables outdoors (between the telephone company's street wiring and your home), call the phone company and ask them to replace it. Beware of telephone lines. As benign as they look, they do carry a "ring" voltage capable of inducing quite a shock, and they need to be well insulated. Don't handle exposed conductors with bare hands. (This hazard only exists during a "ring," but you never know when that might occur.)

You might also try different telephone instruments. The complicated ones with electronic memory for telephone number storage and redial are sometimes more prone to interference than the old-fashioned "no frills" phones, purely because they contain additional electronic circuitry. The old Western Electric-built telephone instruments (remember the 1960s and 1970s?) which had a simple one-transistor tone oscillator, carbon microphone element and mechanical bell ringer were pretty "bulletproof" compared to most of the cheapie imports we use today. You can still find these simple but effective telephones, both new and used.

If worse comes to worst and you can't fix a telephone interference problem, try calling the phone company. Although their line filters are rarely effective, they do occasionally help, and they might find some unique problem in your local wiring or instruments. (But don't count on it: Since the divestiture of AT&T several years ago, I've found the local operating companies critically lacking in technical talent.)

"Grounding station equipment can also help prevent lightning damage in the event of a direct or secondary strike, but is by no means a "fail-safe" precaution."

If worse comes to really worst (like civil actions, threats with deadly weapons, etc.—don't underestimate the actions of a neighbor who can't use his telephone!), experiment with band and power changes. If you clobber your neighbor's phone when using 100W on 20 meters, try 10, 12, 15, 17, 30, 40, 80 meters instead. Or you might try reducing power to the minimum required to make contacts (which is a procedure we're all supposed to follow according to FCC Part 97, anyway). Although I'm an advocate of "Why use low power when a kilowatt will do the job?" thinking myself, experimenting with operating frequency and power level might reveal some useful data. You might find that the interference is frequency-specific, for which the obvious conclusion might be that the telephone wiring in question is resonant on some band you choose to operate. This is good to know, because telephone wiring can be altered in length without any notable change in performance, and simply adding or subtracting some length to your neighbor's telephone instrument wiring might shift the resonance out of the band you're trying to use.

Alternatives

Filters on your transmitters will be of absolutely zero help with telephone interference; however, a good low-pass filter on your HF transmitter *might* help reduce TVI ("might" is the key word here—don't count on it). If you're using modern-day equipment, with a high-quality coaxial transmission line connected to resonant antennas that are well matched, a low-pass filter may not help at all, but that doesn't mean you shouldn't try one. If you do try a low-pass filter on your HF transmitter, get one that is well-shielded and rated for considerably greater power output than you ever intend to use. Transmitting filters used on VHF-UHF transmitters almost never help reduce interference to appliances not intended to receive amateur radio signals.

If you're using an "end-fed wire" HF antenna, this is often asking for trouble. Although end-fed wires work just fine on any frequency where the wire length is not a half-wavelength, it usually means strong RF fields inside your own home, which can coincide with angry family members. There are some compelling reasons to use end-fed wire antennas (like no transmission line loss, regardless of VSWR), but if you have TVI/RFI/telephone interference, they are best avoided.

Experiment with grounding. Sometimes a good, low-impedance ground on your transmitter, or the interfered-with appliance, or both, can help. However, I've seen as many cases where a good ground makes no difference at all, and some cases where the grounding actually made interference worse. "Grounding" is not a magic cure. If you decide to try grounding, there are a few points to ponder:

1. The primary reason for a station ground is not to reduce interference. It is a safety precaution that can help save your life should other grounding systems (such as through your three-wire AC line cord) fail. Grounding station equipment can also help prevent lightning damage in the event of a direct or secondary strike, but is by no means a "fail-safe" precaution. At least one ham I know lost his home to a direct lightning

strike, even though his station was as well grounded as any I've seen.

2. There are differences between types of "grounds." A *DC* ground is any ground path that eventually leads to earth, no matter how long or resistive it may be. An *RF* ground is one offering low *impedance* (not necessarily resistance) to earth on a specific frequency or range of frequencies. It is almost impossible to achieve an RF ground at VHF-UHF since the path to earth would have to be just a few inches long at most. At HF, a true RF ground is achievable, but not easily. One example of a reasonably effective RF ground is the one that I use: a pair of 8'-long copper-clad steel ground rods driven into the earth directly below my operating bench (which is in the garage), connected to the station equipment using 2"-wide tinned copper braid capable of conducting more than 1,000 amperes of current. Such braid costs about $5 per foot retail, and isn't easily found. Also, not many folks can install ground rods directly below, and less than five feet from their station equipment. I did it by using costly masonry drill bits (1"-diameter) to drill through about one foot of solid concrete in my garage floor, then using a 16-pound sledge hammer to pound the ground rods in. This task took several hours to accomplish, since drilling through 12" of concrete isn't easy, and the ground was fairly hard. It also used up two masonry bits costing more than $30 each. And the work would have been impossible to do if the station had already been installed. (I did it prior to building the operating bench or installing any equipment.) Was it worth the expense and effort? Probably not. Do I really have an effective RF ground? Maybe. I wouldn't bet the farm on it.

If you have a second-story (or higher) ham shack, the likelihood of getting a real RF ground to your station is minimal. You're too far away from earth. However, this does not mean you cannot achieve a *tuned,* or frequency-specific, RF ground for a particular frequency of operation. One reasonably effective "counterpoise" (artificial ground, which works for RF but is neither a DC ground nor a hazard-preventing ground) is to use a quarter-wavelength "radial" of wire connected to the ground post of your equipment, with the free end connected to nothing at all! Trust me, it works. The MFJ product which effects an artificial ground and is tunable might also work in some cases.

Cable TV converter boxes also vary in workmanship and engineering quite a bit. Some are in plastic cases which are completely unshielded. Some are in metal enclosures which appear to be an effective shield, but really aren't. Most have only two-wire AC line cords which provide no grounding at all. In some cases I've seen, simply shielding the converter box using household aluminum foil has helped reduce TVI. These "boxes" are really cheaply made and designed to a price, rather than performance, specification. They should cost hundreds of dollars to perform their intended tasks, but in reality they sell for very little and barely work. Most have the insignia of an American company on them, but they're actually built offshore, in Taiwan or somewhere with even lower labor costs. There's nothing wrong with offshore manufacturing, except that these factories often cut corners on what were already cheap designs. If it has an AC power cord on it, the equipment is undoubtedly "UL Listed," which means absolutely nothing with regard to performance.

"Many consumer devices such as personal computers and modems are "FCC Class B" accepted, which similarly means nothing at all."

Check your antenna system, too. If it's an old installation, your connections could be oxidized or corroded, which can help generate higher levels of interference than a system built with shiny new components. Also check your coaxial cable. Brand-new, high-quality coax made by reputable manufacturers is usually pretty good; but lower-cost cables, surplus cables, or ones that have been in use for a few years or more may not be. Coaxial cables, especially when used outdoors, do deteriorate and require replacement.

While SWR is not a figure of merit for antenna performance, it can be an indicator of something being right or wrong. If you are using an antenna with a high SWR and "tuning" it in the shack to make it match better, there is still a mismatch between your feedline and your antenna, and there are still standing waves on your transmission line. Antenna mismatch will often cause transmission line radiation, which may tend to make interference problems worse. Adjust your antennas so they match your transmission line. This is not only more effective than using antenna tuners, transmatches, etc., it can also help reduce radiated interference.

You might also consider raising the elevation of your antenna, to get it farther away from the appliances you're interfering with. I had an interesting experience with TVI on 6 meters (50 MHz). This band is notorious for causing problems with TV Channel 2 reception, since 50 MHz is very close in frequency to TV Channel 2 to begin with. I was running 100W output power to a six-element beam up about 35 feet, and causing TVI to two or three neighbors. I tried several cures, none of which worked. In desperation, I finally tried raising my 6 meter antenna. I raised it to 45 feet, then to 55 feet, and finally to 60 feet, while testing for TVI. All these changes took some time, as I was adding tower sections!

Two weeks or so later, after adding the last tower section that raised the beam to 60 feet, I ran some TVI tests with the neighbors again. The interference had literally vanished! I raised my transmitter power. Eventually, I had 1200W output power on 6 meters (from a pair of 3-500Z's) and literally zero TVI. Previously, I had severe TVI with the same transmitting equipment (and much lower power) and the same beam antenna, but the beam was up only 35 feet. The difference was that when the beam was up 35 feet, it was only slightly above my neighbors' rooftops, and nearly in line with their TV antennas. By raising the antenna another 25 feet I was well above their homes and their antennas, thus considerably reducing the strength of my radiated signal to their TV antennas, even when operating at far greater output power.

Agency Approvals

They mean absolutely nothing. Really. Many consumer electronic and electrical appliances are "UL Listed," "UL recognized," "FCC Class B approved," and so forth. It doesn't mean a thing. U.L.

(Underwriters Laboratories) and C.S.A. (Canadian Standards Association), as well as many foreign agency approvals (T.U.V., V.D.E., etc., ad nauseam) don't mean anything in the real world. Many consumer devices such as personal computers and modems are "FCC Class B" accepted, which similarly means nothing at all. While PCs and peripherals are all "Class B approved," they radiate RF energy like mad, and can similarly receive RF energy that can render them useless in strong RF fields.

U.L. and other agency approvals have nothing to do with performance. U.L. employs almost no real engineers, and has literally zero experience in RF interference or other real-world situations. They "list" or "recognize" equipment based on safety criteria (meaning, the equipment probably won't catch fire when operated according to instructions), irrespective of any performance ratings or criteria. I've dealt with them quite a bit over the past 25 years or so and am extremely unimpressed with their knowledge of electronic circuits. To wit, I asked four different U.L. "engineers" how they determine if electronic equipment is safe for use. Without referring to manuals, not a single one could answer my question. After referring to manuals, none gave a satisfactory answer that even peripherally indicated they had any experience with electronic circuits. If these folks are the "experts," we're in serious trouble.

"This can open a Pandora's Box of problems that will haunt you forever."

When All Else Fails

Ask your neighbors to contact the FCC. Don't be afraid! The FCC isn't out to "get" you. If you're a licensed amateur radio operator and are using your equipment within its ratings and limits (and the limits of your license class), you're probably in good shape. The FCC recognizes that amateurs are licensed to transmit, and your neighbors are not licensed to receive. Reception of television and radio signals is a privilege, not a guarantee. Even telephone calls unencumbered by interference are not guaranteed by the FCC. Indeed, your local telephone utility company guarantees its users some degree of communications which should not be encumbered by radio interference, and if its users find telephone services to be worthless, they really don't have to pay their telephone bills until the problem is corrected.

Utilities are regulated by the Public Utilities Commission, which guarantees users some degree of service in return for fees paid. Communications services are further regulated by the Federal Communications Commission, which recognizes the weaknesses of many user appliances and are usually empathetic with amateur radio operators. It is a ham's responsibility to try his (or her) best to resolve interference problems prior to requesting FCC intervention. But when all else fails, you'll be surprised to find that the FCC is not an enemy, but rather an advocate. I've dealt with the FCC on interference problems more than once, and they've never asked me to stop transmitting yet.

Summary

Interference problems can all be resolved. It takes mutual cooperation on the part of the amateur and the complainant. If the complainant won't let you help him or her, you won't get very far in negotiating with them.

Don't try to "fix" your neighbor's television, radio, telephone, computer or whatever. This can open a Pandora's Box of problems that will haunt you forever. I once voluntarily installed a high-pass filter inside a neighbor's TV set (more than 20 years ago), which did help resolve an interference issue. Two years later, that neighbor tried to sue me for ruining her television, when her picture tube failed and required replacement. (Trust me, I never touched her picture tube.) It's better to recommend filters and so forth, and recommend they be professionally installed or installed by the user. It's even a nice gesture to offer to pay for such filters. I've done it, and I'd do it again, if it makes my neighbors happy.

For a short while I lived in a townhouse community where I had neighbors quite close by. I didn't get into their televisions, but I did cause quite a problem with their telephones. As a neighborly gesture, I offered to buy them all telephone filters. The filters worked great, but it cost me more than $200 to buy all the filters required. This sounds like a lot of money, but I don't regret the decision. It quelled a real problem and allowed me to operate the HF bands without having neighbors complain about it! (One case of telephone interference was so severe, no amount of filtering seemed to help. I offered that neighbor free use of my portable cellular telephone, which had no interference at all, when he needed to call someone and I was on the air. The bills amounted to maybe $10 or $15 a month, but the neighbor was satisfied, I was working DX, and the world was a nice place.)

If you still have problems, write or call me and I'll try to help you out. If you don't, then this article served its purpose. 73 and good DX!

Glutton For Punishment?

Wayne's published a 32-page booklet of his yet-to-be published 73 editorials, in case you just can't wait, or are looking for some cheap, fun reading. 32 pages of small print, so it's packed with ideas, mind-expanding material and book reviews that you'll eventually see in 73.
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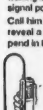

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HAM TO HAM

Your Input Welcome Here

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Since we began this column three issues ago, a number of worthwhile ideas have been received and they continue to arrive daily. Many thanks to all who've contributed their time and effort to make this a success, and I'm hopeful that the response seen so far will grow even more enthusiastic in the future...remember, this should be your column, with your ideas and suggestions.

Here's a basic rundown of what I'm looking for in the way of reader input. Everyone has different experiences in amateur radio, with different equipment and varying setups; each of us has encountered any number of instances where we've made improvements, both major and minor, to what the equipment manufacturers "think" that we want. Some of the modifications are primarily operational in their nature, others make the equipment more technically sound. I'd like to hear about your innovations, with the possibility of passing them on to all of the others reading this column. That's what "Ham To Ham" means, one ham's helpful hits, ideas or suggestions to another who might be in a similar situation or have similar needs. Hams have always enjoyed helping one another, that's part of the fun of the hobby, and this column is a way of extending that helpfulness to many, many others all at once.

Not everyone wants to write a complete, long, drawn-out article on an innovative idea that they may have come up with, so here's your chance to jot down the basic details, in casual form, and I'll put the finishing touches on it, if need be, for the column. Don't worry about your writing style, just try to be as complete as you possibly can, but even if you're not sure, send it to me and I'll let you know if I feel that more information is needed. I'm primarily interested in down-to-earth, practical ideas that others can duplicate with relative ease. Here's an example of a simple idea, something that's easily duplicable by most hams, yet many may have been reluctant to apply it to their own situation.

Pilot Lamps and Today's Radios

Have you noticed how difficult it's become to change a burned-out pilot lamp in most of today's modern transceivers? In the "good old days"—when radios and pilot lamps were both a lot bigger—changing a dead lamp was a pretty straightforward, easily accomplished job. Lamps were usually mounted in sockets, and normally just a twist of the wrist popped the lamp right out, ready to install a new one. Not so anymore! Most lamps are now on tiny wires, soldered in place and often buried deep within the radio's front panel wiring. It's become such a problem that many hams don't bother changing the lamps when they do burn out, or they wait until something else much bigger in the set needs attention, changing the pilot lamp then as something of an aside to the larger problem.

What follows may not make the task of lamp replacement any easier, but it might just double or triple the time between pilot lamp failures, and it's not usually too difficult to accomplish.

Here's the first tip: When a pilot lamp does burn out, most hams probably think in terms of going to the radio's manufacturer for a "direct replacement," but often that's the most expensive and time-consuming route to take. Here's an alternate approach that's ordinarily much, much easier. Radio Shack stores stock a number of small, low-voltage lamps, most of which work on what your transceiver supplies as pilot lamp voltage—usually 12 volts DC. By the way, using a replacement lamp rated at a higher voltage is fine, just as long as it will provide enough brightness once it's in place. In fact, a higher voltage lamp will last quite a bit longer than one that's rated right at the nominal supply voltage. That leads us into the rest of the story. How do you extend the life of those tough-to-get-at little pilot lamps?

If you lower the supply voltage to any incandescent lamp, you'll increase the lamp's life dramatically. Tests have shown that the life expectancy of an incandescent lamp zooms upward as the voltage across it goes down, and of course, vice versa. Lowering the voltage across a 12-volt lamp by just a couple of volts, for instance, will extend the lamp's expected life by two or three times! Just a series resistor in the lamp's supply lead will do it for you, but there are some other considerations. You'll have to determine how much light loss is acceptable in your particular operating configuration, because there will be loss of brightness if the voltage to the lamp is reduced. Once you have determined how much illumination you can afford to lose, you'll need to know the value of the resistor needed to drop the voltage just enough to accomplish that objective. Finally, the power to be dissipated by the resistor will determine what wattage resistor is needed.

Lowering the voltage across an incandescent lamp will definitely reduce its light output and it will also shift its color somewhat toward the red region. The more the voltage is lowered, the more red-shift occurs.

I have a couple of flood lamps illuminating the front of my house each night that are wired in series, i.e., the lamps run at 1/2 voltage across each lamp. They're very much on the "warm side"—red-shifted—but have been going for years and years each night without burning out, because voltage-rating-wise, they're loafing along!

Getting back to our pilot lamp discussion, you can easily determine what resistor to use in series with each lamp by using Ohm's Law: Voltage drop desired (V) divided by the lamp's rated current (I) equals the correct resistor (R) needed and Voltage drop (V) desired times the lamp's rated current (I) equals the resistor's wattage (P).

By way of example, let's take the Radio Shack #272-1141 lamps mentioned earlier, which have a current rating of 25 milliamps—or 0.025 amp—and assume that we would like to drop the 12-volt lamp supply by 2.5 volts—down to 9.5 volts. Plugging in these values we get: 2.5 volts ÷ 0.025 amp = 100 ohms and 2.5 volts times 0.025 amp equals 0.06 watt.

Now we know that we'll need a 100-ohm resistor in series with each lamp, and that a 1/2-watt dissipation rating on each resistor will give us a good margin of safety.

Another way to lower the voltage to all of the lamps in the set at one time would be to use a 3-terminal adjustable voltage regulator supplying something less than 12 volts to the lamp supply bus, but in most cases, that's something of an overkill. You would also have to be sure that nothing else is tapped off of the lamp supply bus that might be adversely effected by a slight voltage reduction. The individual resistor in series with each lamp is usually the safest approach unless you know the transceiver's circuitry well.

Remember, the more you can lower a lamp's voltage from its nominal rating, and still have enough light output from it, the longer that new pilot lamp will last once it's in service.

Reducing Scratches

Sometimes accidents happen, and a plastic meter face, dial cover or even a wristwatch faceplate can become marred with an ugly scratch or dig, often making it difficult to even read through the scratch mark.

Next time that happens to you, try using a small amount of metal polish, such as Brasso™, to polish out the imperfection...it really works. Most of these products are composed of a very fine abrasive that, if used properly, will eliminate or minimize many scratches—even relatively deep ones—restoring the damaged piece to usable condition again.

Try folding a paper napkin, and with the tip of your finger

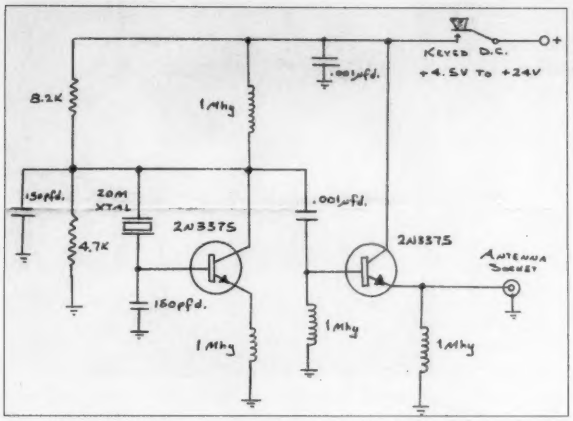

Fig. 1. *4X1UF's ultra-compact 20 meter CW QRP transmitter schematic diagram. See text for further details.*

backing it up, apply a small amount of polish to the damaged surface. Take your time, applying only the amount of pressure needed to remove enough of the surface plastic to polish out the scratches in question. You might want to try this on a couple of scrap plastic pieces first, just to get a "feel" for the procedure. Rub over the scratch several times and then wipe the dried polish completely off. If the surface has "fogged" a bit, repeat the procedure, but this time using progressively lighter pressure.

For very light scratches, even ordinary typing paper may be just abrasive enough to polish the surface sufficiently. Try using the paper just as is—without any additional external abrasive applied to it.

Most reasonably sized marks—and even some pretty big ones—can be removed or greatly reduced in this manner. It even works on scratched CD-ROM disks, but again, better to practice on a "throw-away" one first.

Submitted by: Herb Foster AD4UA, 3020 Pennsylvania Street, Melbourne, FL 32904-9063

Moderator's Note: most cleansers and polishes will exhibit the abrasive effect that Herb refers to above, so you might want to try a number of them—keeping notes on which work best for you—on several samples of scrap plastic. You might also want to try a mild-abrasive automobile rubbing compound or an optical lens grinding compound as well. Jeweler's rouge, a very fine abrasive in an oil-based cake form, is also very useful in the same manner—you might check with a jeweler's supply house or your own neighborhood jeweler to see about obtaining a small container for the next time you need it. Jeweler's rouge is also excellent for cleaning tarnished connector contacts and intermittent battery connector springs, as well as your XYL's gold rings and bracelets! Brasso, mentioned above, is a registered trademark of Reckitt & Coleman of Wayne, NJ.

Two-Stage QRP Transmitter

All the way from Israel, Lavee 4X1UF contributed this interesting little two-stage, 5-watt, 20-meter CW QRP transmitter circuit for experimental purposes.

In the circuit diagram of the Fig. 2, the first 2N3375 transistor is wired as a Pierce Oscillator, and is capacitively coupled to a second 2N3375 that functions as a buffer as well as an impedance converter. Lavee writes, "...by drawing as much current as needed by the stage," the second 2N3375 "...acts as an automatic antenna tuner. The lower the impedance, the higher the current" drawn from this stage. The need for an external antenna tuner is therefore minimized, except perhaps as a tuned circuit for harmonic reduction, since no tuned circuits are employed within the two-stage transmitter itself. These days, some sort of harmonic reduction would be well advised.

Lavee built his unit into a very small copper box, bolting the 2N3375s directly to the box and bringing the RF out via an RCA-type "phono" jack. Direct point-to-point wiring is used, with all grounds soldered right to the copper box itself with the shortest possible leads. With 24 volts keyed DC applied, he was able to realize about 5 watts of RF output on 20 meters. He further cautions that the box can get very warm after a time, so either additional heat-sinking might be required, or key-down time kept to an absolute minimum—lower V_{cc} input voltage would also reduce heat, along with the output power. A small 12-VDC fan might be a worthwhile addition if the heat dissipation is still too great. Lavee commented that after final testing, he covered all of the internal components with a heat-dissipating epoxy for additional component mechanical stability as well as better heat transfer.

"The need for an external antenna tuner is minimized, except perhaps as a tuned circuit for harmonic reduction."

From 4X-land, this is an interesting circuit with lots of potential for QRP enthusiasts. Questions and comments should be directed to: Lavee Israel 4X1UF, c/o International Electronics Services, 12/21 Got Levin St., Haifa 32922, Israel.

That's our "Ham To Ham" column for this month. Please keep your ideas, tips, suggestions and shortcuts coming and we'll use as many of them as possible in each of the coming months. Please send them to the address at the top of this column, not to *73 Magazine* directly.

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73 Magazine's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator, nor to *73 Magazine*.

73, de Dave NZ9E. 73

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More About Hamcon/ Foxhunt-95

"We need more young people in ham radio!" Wayne says it, I've said it, and you have probably said it, too. What if I told you that there is a way for kids of almost any age to learn about radio without realizing they are being educated, while they have so much fun they won't want to stop? They'll also be getting lots of fresh air and exercise, far more than they would get sitting in front of a computer screen. Best of all, the kids don't need to be licensed; they can start immediately.

Yes, such an activity exists. In some eastern European and Asian countries, it is so popular that it's part of Physical Education in schools. The sad fact is that it's rarely done stateside. Hams in our education industry haven't discovered it yet. This best-kept secret is a sport called "foxhunting."

Hide-and-Seek With Radios

Unlike more familiar mobile "T-hunts," an international-rules foxhunt is an on-foot search for several concealed mini-transmitters in a large outdoor setting. Kids love it, and so do adults. I explained the concept in detail in last month's "Homing In." I also began the story of Hamcon/ Foxhunt-95, Southern California's first international-style radio direction finding (RDF) championship. It was held September 3 on the Fort MacArthur Military Museum grounds in the San Pedro area of Los Angeles. I served on the committee of Southern California Six Meter Club members who put on this 2 meter event for the 1995 ARRL Southwestern Division convention.

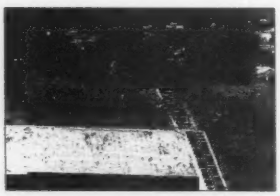

***Photo A.** Fox #3 was next to the long staircase on the edge of Batteries John Barlow and Saxton, an abandoned WWI shore defense site at Fort MacArthur. One hunter hasn't realized yet that he is standing on top of it.*

Hamcon/Foxhunt-95 simulated as closely as practical a European/ Asian foxhunt. Our rules were based on International Amateur Radio Union (IARU) rules for direction-finding championships. Unlike IARU events, there was no separate division for women and competitors in all divisions were required to search for all foxes. Age divisions were different from IARU classifications.

International-style foxhunting is new to Southern California, but that doesn't mean all Hamcon/ Foxhunt-95 participants were complete greenhorns. Many of the forty who signed up were experienced mobile T-hunters who had learned techniques for "sniffing" out transmitters on foot, whereas others had never tried RDF before. How could we put on a hunt that challenged the experienced T-hunters but gave first-timers a chance to do well?

The fox-hiding subcommittee decided to put out six foxes. Two transmitters would be easy to find, two would be really tough, and two would be in-between. Foxes #6 and #2 were intended to be the easy ones. We hid #6 under the concrete cover of an abandoned 40-year-old underground command post for Nike defense missiles on a hilltop 900 feet southeast of the start point. The antenna for Fox #2 was N6MI's horizontal dipole in a tree 400 feet west of the finish line. Both of these foxes were high and in the clear, relatively speaking, so hunters should have gotten sharp bearings.

IARU rules require red and white flags (called prisms) next to each fox. They are appropriate in the deep-cover forests where world championships are held, but they would have been far too conspicuous in the fort areas. So we did not use them. The bright orange punches within five feet of each transmitter were easy to spot and provided sufficient visual identification.

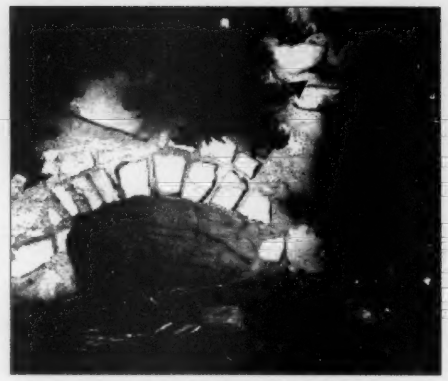

***Photo B.** The most dastardly fox hiding spot was deep inside this drainage channel, 200 feet from the beach. The orange card-marking punch is just barely visible in the wall-climbing plants.*

Fox #3 was supposed to be very hard. It was on the steep slope of a 50-foot-deep football-field-sized pit that used to be part of a World War I mortar emplacement (Photo A). Its antenna was a twin-lead J, most of which was buried a couple of inches into the dirt next to the long stairs. The idea was to "light up" the entire pit with lots of RF and create many signal reflections. The ultimate challenge was Fox #4, which was underground, five feet into a sea-level drainage channel near the southern end of the park (Photo B). All foxes except #4 were at least 50 feet from the nearest trail.

The shortest possible route reached the foxes in the following order: #3, #5, #6, #1, #4, #2. Hunters traveling that route directly would have gone 1.35 miles. This is about one half of the shortest route in a typical IARU championship foxhunt. Of course, nobody's route was close to being that short. Overall winner Scot Barth KA6UDZ found all foxes in 66 minutes and Senior Division (over age 46) winner Marvin Johnston KE6HTS did it in 76 minutes (Photo C). By comparison, a Hungarian and a Russian completed a much longer five-fox 2 meter course in just 47 minutes at the 1994 World Championships in Sweden.

According to the fox-hiding corollary to Murphy's Law, "Everyone will easily find the foxes that you think will be hard, and vice versa." The pit didn't create a pool-table effect for Fox #3 signals. Eighteen hunters found it. On the other hand, the high horizontal dipole of Fox #2 must have caused some unusual signal reflections, because many hunters reported that bearings to it crossed on top of a hill 400 feet northeast of it. The fox found by the most hunters (28) was #5; the one found by the fewest hunters (8) was #1. Both had been expected to be medium difficulty foxes.

This foxhunt was the last event of the convention, on Sunday afternoon. All day Saturday, a half dozen or so "micro-Ts" transmitted for a few seconds each from hiding spots around the Queen Mary convention site, including the hotel, exhibit area, and parking lot. This gave everyone a chance to check out RDF gear and practice techniques.

A few eager entrants didn't wait until Saturday to get ready. Rick Barrett KE6DKF, who

***Photo C.** Marvin Johnson KE6HTS picked this high spot overlooking the ocean to take a bearing. He took first place in the Senior Division.*

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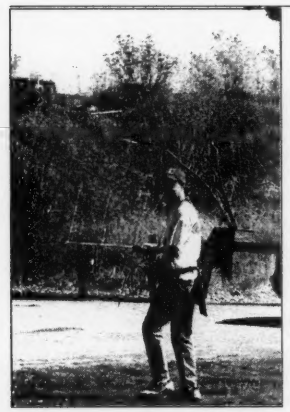
Photo D. Tom Mirabella KD6AAN, age 14, took first place in the Youth Division. He found more foxes than his dad, Ken KM6YH.

placed third in the Prime Division (ages 18 through 30), was glad he had practiced diligently. "Scott Barth KA6UDZ, another hunter, and I went up to Glendora to a local sports park several times," he told me. "We would each hide a fox in the park and then we'd hunt each other's foxes down. Once we found all of them, we'd move them and find them again. We did it after dark so we would not see each other hide them. This allowed us to get used to our equipment, so we could trust it and not just what we saw."

Everyone Is Able

Fox hunters who win international championships are true athletes who train just like world-class competitors in any other running sport. By contrast, Hamcon/Foxhunt-95 entrants were a cross section of ordinary hams, ranging in age from 11 to 70 (Photo D). The median age was 38. There were no cross-country runners, and two could not run at all. The story of these two is proof that foxhunting is a sport for almost everyone.

Photo E. Mike Obermeier KD6SNE "sniffs" in his wheelchair and T-hunts regularly on 2 meters in a converted mail delivery truck with a 4-element quad and a Roanoke Doppler. The photo isn't backwards; the steering wheel really is on the right side.

Mike Obermeier KD6SNE is a regular at Southern California mobile T-hunts. Because of a spinal cord injury, Mike has adapted his T-hunt vehicle to include hand controls for the accelerator and brakes (Photo E). In just a few seconds, he can maneuver himself out of the truck and into his sports wheelchair for sniffing out the T.

When I promoted this foxhunt at a mobile T-hunt in August, Mike told me he really wanted to compete. He kept asking, "Can I do it in my chair?" I knew the site had plenty of paved and unpaved trails, but there would be no way to place all the foxes so he could roll right to them. There are no provisions in the IARU foxhunt rules for this sort of situation. Mike didn't want a special course just for him, nor did he want the course made easier on his account. All he needed was a way to finish closing in after he had done the basic RDF work on wheels.

Fortunately, I had an expert nearby for consultation. My wife April WA6OPS is a Registered Occupational Therapist and former rehabilitation department head at a major medical center in Orange County. Occupational Therapists are trained to find creative ways for persons with disabilities to adapt to their physical limitations and

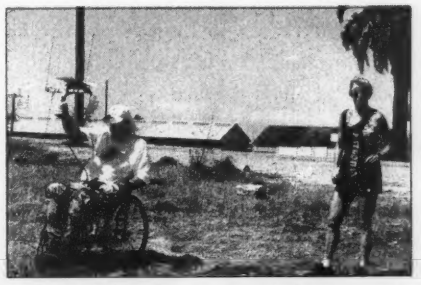
Photo F. KD6SNE cruised the foxhunt course in his wheelchair. Christie Holoubek KØIU, his Extender, went into the brush on his command to uncover foxes and punch his competitor card.

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***Photo G.** On the downhill, KØIU had to move fast to keep up with KD6SNE.*

return to regular activities of their daily living.

April suggested that Mike be provided with an assistant on the foxhunt course to perform search duties in areas of the park that were inaccessible to his wheelchair. I countered that the competition was for individuals only, not two-person teams, and that other contestants might consider it unfair to go up against the team of Mike and an assistant. After some discussion, we agreed that the assistant would be selected by the hunt committee and would be allowed to act only as an extension of Mike's range. Mike would do all the RDF work and maneuver his chair as close as possible to the foxes. Then Mike's Extender would go into any inaccessible places and search, without equipment, at his direction (Photo F).

Mike thought this idea was great and quickly agreed to the terms and conditions. Christie Holoubek KØIU agreed to act as his Extender. There was no concern about Christie being able to keep up with Mike, because she is an accomplished marathon runner (Photo G).

One week before Hamcon/Foxhunt-95, I received e-mail from Marvin Johnston KE6HTS of Santa Barbara. He and Dennis Schwendtner WB6OBB were coming to the hunt and he wanted to know if Dennis could participate on a team. I already knew that WB6OBB's keen hearing had made him a successful "navigator" on mobile T-hunts in Santa Barbara for many years, despite the fact that he is sightless. I told Marvin that there would not be a team competition, but we would try to find another good Extender so that Dennis could hunt.

WB6OBB liked the idea, so April asked an acquaintance who had expressed interest in amateur radio to be his Extender. April's instructions were that she could act only as eyes for Dennis, and could not do any RDF for him. Besides insuring his safety, she was allowed to describe to Dennis the terrain features and the presence of other hunters in the area in which they were searching (Photo H).

No one at the foxhunt starting line was more excited than Mike and Dennis. Of course, not all sporting events turn out like a Rocky or Mighty Ducks movie. Neither Mike nor Dennis won a medal. However, both received certificates for successfully finding foxes, and their extenders got a real workout. I'm sure all four are hoping that organizers here and abroad will improve the rules so all future international-rules foxhunts are as accessible to handicapped hams as this one was.

As you can see from the photos, Hamcon hunters used a wide variety of RDF gear, from the commercial sets used by KE6HTS and KD6SNE to KD6AAN's yagi and the foil-tube attenuator of WB6OBB. Every hunter has personal preferences for equipment. Selecting just the right sniffing setup for your needs will be the topic of an upcoming "Homing In" column. Meanwhile, keep me informed about both mobile T-hunting and on-foot foxhunting in your area. Write to the address at the beginning of this article or send e-mail to me via Internet (Homingin@aol.com) or CompuServe (75236,2165). 73

***Photo H.** Long-time T-hunter Dennis Schwendtner WB6OBB didn't let his blindness keep him from having fun at Hamcon/Foxhunt-95. Future ham Linda Reagan served as his Extender.*

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The AMSAT Annual Meeting

The 1995 AMSAT Annual Meeting and Space Symposium was held October 6-8 in Orlando, Florida. Over 200 satellite enthusiasts listened to dozens of presentations and visited the Phase 3D integration facility. For all participants it was a fantastic weekend. STS-73 was scheduled for launch during the weekend only 40 miles away at the Cape, but due to weather and other delays, it was a hamsat weekend and not a hamsat/shuttle weekend.

Photo A. Phase 3D Satellite Project Leader, Dr. Karl Meinzer DJ4ZC, addresses the 1995 AMSAT Space Symposium in Orlando, Florida.

Friday

This year the presentations began Friday before noon with a paper by Bob Bruninga WB4APR about a new software program called APRtrack. Gwyn Reedy W1BEL of PacComm described the capabilities of the program and its use for determining the locations of ground stations and spacecraft using packet radio and GPS (Global Positioning System) data. Shareware versions can be found on various BBSs, while registered copies can be purchased from WB4APR or AMSAT. AMSAT VP for Manned Space Activities Frank Bauer KA3HDO, John Nickel WD5EEV, and Matt Bordelon KC5BTL updated the group on the progress of SAREX, the Shuttle Amateur Radio EXperiment. SAREX did very well in 1995 with random QSOs and many fine scheduled contacts with schools from the ham-astronauts.

Ignacio Martinez CE2MH of AMSAT-CE (Chile) described the Fodtrak tracking and tuning software. The program was developed in Chile to help fund the satellite CESAR-1.

Other afternoon talks included methods of developing and utilizing satellite gateway nodes by Barry Baines WD4ASW, development of microsat ground station software for Linux and X-Windows by John Melton GØORX/N6LYT, ways to extend the lifetime of scientific satellites by Philip Chien KC4YER, and details on the success of the joint AMSAT/TAPR (Tucson Amateur Packet Radio) DSP-93 project. The Texas DSP-93 crew included TAPR President Greg Jones WD5IVD, Bob Diersing N5AHD, Bob Stricklin N5BRG, and Frank Perkins WB5IPM.

Finishing the afternoon activities was Phil Karn KA9Q with a demonstration of digital voice via the World Wide Web on the Internet.

A brief dinner break followed. Evening presentations began with a slide show on satellite DX by Mikio Mouri JA3GEP.

Doug Howard KG5OA followed with the latest exploits of balloon enthusiasts in Texas. He described the many payloads in previous and current packages that the groups send to the edge of space.

David Liberman XE1TU showed a video of the attempted launch of UNAMSAT-1 on a converted Russian ICBM. The launch failed, but UNAMSAT-2 is nearly complete, waiting for a chance to become an OSCAR (Orbiting Satellite Carrying Amateur Radio).

Dan Schultz N8FGV delighted the audience with his pictures from the Hubble Space Telescope. Dan showed several new and exciting images from the telescope taken after the Shuttle repair mission. He had a few picture copies which were included as handouts for those attending.

Bruce Paige KK5DO finished the Friday talks with his description of the efforts in Houston to get the local Houston Area AMSAT Net out to as many hamsat enthusiasts as possible via commercial geostationary satellite link and HF. The Houston net can be heard every Sunday night at 10 p.m. Central time on Telstar 302, Transponder 21, 5.8 MHz audio subcarrier or on 1860 kHz am from Missouri. Many VHF and UHF repeaters in North America also carry the net via the satellite feed.

Photo B. AMSAT VP of Engineering, Dick Jansson WD4FAB, coordinated the Phase 3D talks at the AMSAT Symposium.

Saturday

Activities began in earnest at 8 a.m. AMSAT President Bill Tynan W3XO gave an official welcome to the symposium participants.

With the scheduled launch of Phase 3D only a year away, the focus of the symposium was on the new satellite. AMSAT VP of Engineering Dick Jansson WD4FAB moderated the morning talks, all dealing with progress of the Phase 3D program.

Project Leader Dr. Karl Meinzer DJ4ZC brought participants up to date on launch opportunities, financial considerations and an overall picture of the program. The planned launch is to occur late in 1996 on the second flight of an Ariane 5 vehicle. If there are difficulties with the schedule, the satellite may be launched as late as mid-1997 on an Ariane 4 rocket. Phase 3D is on schedule, but still needs more money to pay for launch costs and the many other items that come with any launch campaign.

Most of the mechanical efforts for Phase 3D are the responsibility of AMSAT-NA (North America). Dick WD4FAB presented details on the structural and thermal design, while Stan Wood WA4NFY followed with antenna location and other considerations. It has been quite a challenge to orient the spacecraft antennas on one face of the satellite without causing interaction problems.

AMSAT Board of Directors member Dick Daniels W4PUJ related information on the propulsion system. The satellite has a kick motor similar to the previous Phase 3 satellites, but it also has an ammonia arc-jet motor that will be used for many months during final "tuning" of the orbit. The plumbing for the motors is in place and waiting for final wiring.

Lyle Johnson WA7GXD and Chuck Green NØADI

Photo C. Stan Wood WA4NFY and his cake-pan, 1.2 GHz backfire antenna.

Photo D. AMSAT Board member and past President, Dr. Tom Clark W3IWI, shows one of the L-band "salad bowl" antennas for Phase 3D.

characterized various Phase 3D computer systems. The main operations computer is called the IHU or Internal Housekeeping Unit. Other computers include the GPS system and the RUDAK digital communications controller.

Peter Guelzow DB2OS covered the Controller Area Network or CAN that will be used for digital communication between subsystems onboard Phase 3D.

AMSAT President Emeritus Dr. Tom Clark W3IWI described his Global Positioning System (GPS) experiment for Phase 3D. Bdale Garbee N3EUA and his crew have been working on the GPS computer subsystems and writing software for use in the spacecraft. Bdale passed several prototype boards around the audience during his talk.

Hiroyuki Ohata JM3MAJ brought a prototype of the SCOPE digital color imaging experiment with him from Japan. His presentation provided details on the specifications of the two-camera unit. The

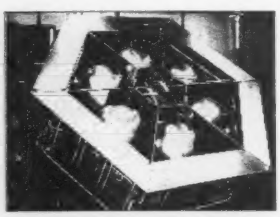

***Photo E.** The Phase 3D satellite is progressing well at the AMSAT lab in Orlando, Florida.*

***Photo F.** Integration Laboratory Manager Lou McFadin W5DID in the clean room with Phase 3D shows the location of one of the 12 magnetorquer rods to be installed.*

equipment will be located in the spacecraft with holes strategically located to allow the cameras, one wide angle and the other narrow, to view the earth at the orbit's high point or apogee.

AMSAT Integration Laboratory Manager Lou McFadin W5DID wrapped up the morning talks with data on the complex wiring harness for Phase 3D and methods now used in the lab to keep up with all the parts to be built into the 1,000-pound satellite. Lou joined the project after retiring from NASA at the Johnson Space Center in Houston.

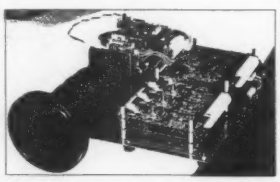

***Photo G.** A prototype of the Japanese SCOPE Digital Color Imaging Experiment camera was on display at the symposium.*

Afternoon sessions concentrated on future satellite programs. Peter Vekinis KC1QF/EI4GV got things started with ideas about very small satellites, or picosats. Measuring only five inches on a side and incorporating active three-axis stabilization, Peter proposed a constellation of picosats in low earth orbit, all using VHF and UHF frequencies. While still in the early planning stages, the program is thought provoking and may provide future satellite builders with ideas.

Steve Bible N7HPR discussed his efforts with the World Wide Web Amateur Satellite Ground Station. For those with Internet access, the address is http://gndstn.sp.nps.navy.mil

The system Steve created maintains data received from the 9,600-baud amateur satellite (UoSAT-Oscar-22, Kitsat-Oscar 23 and Kitsat-Oscar-25). Steve also gave an update on the PANSAT project sponsored by the Naval Postgraduate School in Monterey, California. Using spread-spectrum techniques, this small satellite is scheduled for launch in 1997 and will use the frequency range from 435 to 438 MHz for both uplink and downlink. Work has begun with TAPR to provide earth-station hardware and software to communicate with the satellite. Updates on the PANSAT project can be found via the Internet at http://www.sp.nps.navy.mil

SEDSAT Project Manager Dennis Wingo KD4ETA brought everyone up to date on the status of the SEDSAT program. SEDSAT-1 is a microsat-class satellite that will be part of NASA's Small Expendable Deployer System (SEDS). Changes in launch schedules have caused delays with this hamsat. SEDSAT will carry several scientific and amateur-radio experiments. The main purpose of the satellite is to test the dynamics of tethered satellites and remote sensing. The SEDSAT program also has a World Wide Web home page at http://seds.lpl.arizona.edu

Ken Emandes N2WWD completed the afternoon talks with an enlightening description of his efforts to properly identify the Russian RS-15 satellite and its orbit. Orbital data from NORAD and NASA

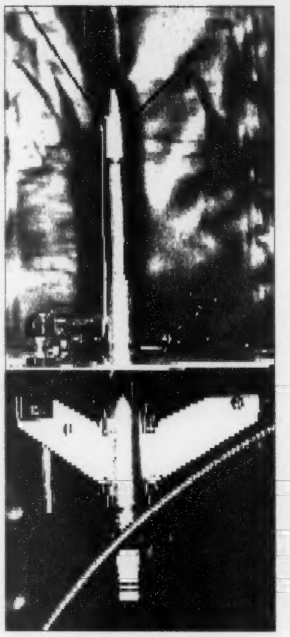

***Photo H.** The ammonia arc-jet motor will be on for several months after launch to fine-tune the orbit of Phase 3D.*

was inaccurate in the early days following the launch of the satellite. Ken determined that the upper-stage vehicle had exploded leaving many radar targets in the area of the satellite. Determining which space objects were nothing but debris, and which was RS-15 became a challenge. While NORAD used their sophisticated radar systems to catalog the objects, Ken used both the NORAD/NASA data in conjunction with the 10 meter ham-radio signals transmitted by RS-15 to characterize the orbit and identify the satellite.

After Ken's talk, AMSAT President Bill Tynan introduced the officers and Board of Directors' members. Each officer or director was given a chance to speak to the group. It was also a time for questions and answers from the attending AMSAT members.

Following a short break to allow everyone to catch their breath and relax after data input overload, the yearly banquet began. The speaker was Dr. Paul Shuch N6TX. Last year he talked about "The

Search for Dark Matter." This time he provided details about the SETI League. Paul is now the Executive Director of the organization and provided everyone with an informative, yet light, discussion on the search for extra-terrestrial intelligence. He has that unique ability to make the most complex topic both understandable and fun.

Bill Burden WB1BRE of the American Radio Relay League presented AMSAT with a check for $305,000. This was

Photo I. Stan Wood WA4NFY and Tom Clark W3IWI discuss one of the GPS antennas being prepared in the AMSAT lab in Orlando.

the result of the ARRL Matching Fund program run earlier in the year to help finance Phase 3D.

Prizes and AMSAT awards finished the evening. The prizes ranged from books, T-shirts and maps to gear from SSB Electronics, 50 copies of Windows NT from Microsoft, and a mobile transceiver.

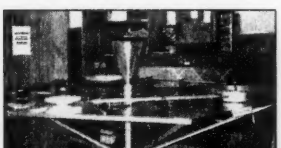

Photo J. A mock-up of the "earth" side of Phase 3D is used to test antenna locations in the lab.

Sunday

Following the Field Operations Breakfast at 7:30 a.m., Bill Tynan started the AMSAT Board of Directors' meeting,

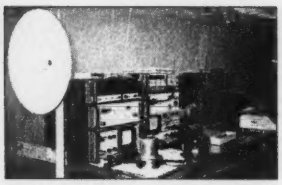

Photo K. One of the test equipment benches in the AMSAT lab in Orlando.

which lasted through mid-Monday with a few breaks for food and sleep. The agenda covered many items including publications, SAREX, the DSP project status, long-range planning, commercial relationships, new satellites and the budget.

The Phase 3D program was the main topic this year. AMSAT still has a significant challenge ahead to pay its part of Phase 3D and maintain other activities. Work on fund raising will continue to dominate AMSAT's operations until launch.

Parallel to Sunday's BoD meeting, guided tours were provided of the AMSAT lab facility at the Orlando airport. A chartered bus furnished transportation for those interested in viewing the progress on the satellite and improvements to the lab. Many displays and demonstrations were provided.

Tucson, Arizona, is the site for the 1996 meeting. It is sure to be a fascinating event since Phase-3D will be completed and waiting for launch. Don't miss the Friday talks. Be sure to come early. Copies of the *Proceedings* of the symposium are available from AMSAT or the ARRL. The book is 8 1/2" by 11", 182 pages, and softbound. It's well worth the cover price of $12.00. AMSAT can be contacted at 1-213-589-6062 for details on shipping charges.

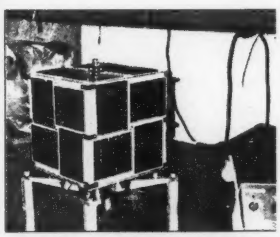

Photo L. A microsat model from five years ago resides in one corner of the AMSAT lab in Orlando.

Straight Key Night

For many years the ARRL has sponsored Straight Key Night (SKN) on New Year's Eve and New Year's Day. In

Photo M. Steven Bible N7HPR discussed Internet connections for satellite telemetry monitoring and future modes for digital satellite communications beyond Phase 3D.

1972, a group of satellite chasers decided to try their hand at some straight key CW via OSCAR-6 during SKN. The idea caught on and the tradition has been maintained whenever there has been a satellite available for the event.

AMSAT Vice President of International Affairs Ray Soifer W2RS invites interested satellite operators to participate in the 24th annual SKN via OSCAR. He reports that there are no rules, no scoring, and no need to send in a log. Just call CQ SKN in the CW passband segment of an OSCAR between 0000 and 2359 UTC on January 1, 1996, or answer a CQ SKN call from another station. Contacts via the moon also count. Nominations for best "fist" can be sent to W2RS@WA2SNA.NJ.USA.NA via packet or to W2RS@AMSAT.ORG via the Internet. You can also use his Callbook address.

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I guess I should begin this month by paying attention to the date on the cover of the magazine, and wishing each and every one of you a *Happy New Year!* My most sincere wishes for a Healthy and Happy 1996 to all of my readers. With this interest in time, I have several items of interest to the ham paying attention to this detail of our lives.

To begin with, a new program has hit the market, called WinZones, billing itself as a "comprehensive time zone utility for Windows." Produced by Extend, Inc., in Pleasanton, California, the program generates a number of customizable clocks on the Windows desktop. It is available in versions for both Windows 3.1 and Windows 95, and I have reviewed the Windows 95 version.

As you can see in Fig. 1, the program's window can be filled by a clock, either analog or digital, which may be set to any time zone. A variety of cities are provided in a data file, which allows the generated clocks to highlight time zones around the world. The four clocks from my screen demonstrate the degree of customization possible. Clocks may be analog, using Arabic or Roman numerals, or digital. Typefaces, size, and color of the clock may all be changed at will. There is even an alarm function, indicated by the red arrow on the Jerusalem clock in the Fig. 1, that can be used for any purpose where an alarm might come in handy.

Indicators on the clock face indicate daytime or nighttime by a little tree in the sun or moon being displayed, and daylight savings time may be activated individually for each clock to allow for differences in daylight savings time observance in different areas.

The program installs easily, using the common "a:setup.exe" routine. It opens the Setup Wizard, which quickly steps you through the installation process. Although the program configures itself to open with four clocks, this is quite easily changed to whatever your heart desires. Additional clocks may be opened on the fly, so to speak, and closed again without affecting the rest of the program.

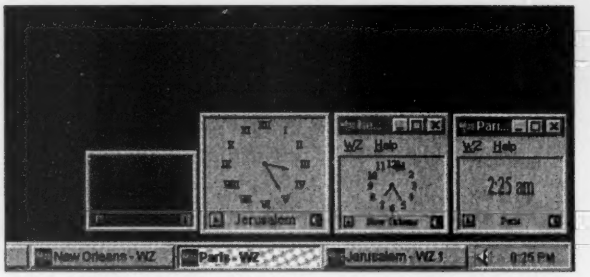


Fig. 1. A WinZones screen in Windows.

Unfortunately, uninstalling the program is not so easy. While there is an uninstall routine, as required of Windows 95 compatible programs, it fails when called, indicating that it cannot find the uninstall log file. Since all the files appear to be installed in one directory, erasing that directory effectively gets rid of the program. However, I cannot tell, at this point, if there are not some scattered INI files, pointers, or registry data remaining.

In short, if you have a need for several clocks on the screen at one time, WinZones may be just what you are looking for. Windows 95 comes with a clock of its own, on the taskbar. So, if you have no trouble converting from local time to GMT or the time zone of your current contact, this product may be overkill. If you are interested, contact Extend and tell them you read about it in "RTTY Loop."

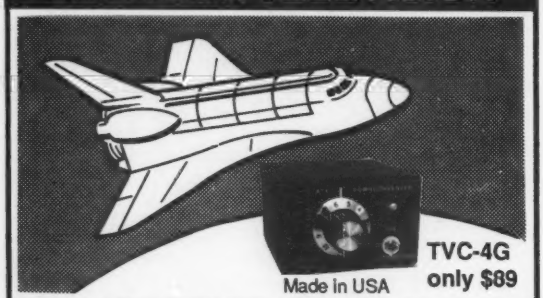
Now, if all you want is an analog clock on the screen, instead of the little digital taskbar icon, check out rclock.exe, one of the "powertoys" from Microsoft. Available free on the Microsoft Home Page, as well as other bulletin boards near you, this little darling puts a round clock on your screen, through the magic of Windows 95's sophisticated windowing system. Of course, you can configure it to be a digital clock as well. While you can't use it to put multiple clocks on the screen, and it can only display the system clock time, it may be all you need. If you want this little darling and can't find it in your neighborhood, I wouldn't be surprised if it didn't turn up on a RTTY Loop Software Collection disk, real soon!

With all these clocks, you might want to know what time it is — for real! That need takes us to our web site of the month, a page which will give you the correct time, down to the fraction of a second, direct from the U.S. Naval Observatory Master Clock. Point your web browser to: http://tycho.usno.navy.mil/what.html and you will see a Daliesque graphic and a button to push. Pushing the button will give you a spread of times from a variety of sources. Given the delays inherent in the communications system, I would not calibrate a clock to the hundredth of a second, but it is more accurate than that sundial in your backyard. Enjoy!

Albeit a bit late for some of you, my apologies to anyone I have kept waiting for either a list of programs or software collections. While I would like to spend most of my day on ham radio or computers, the demands of my practice, family, and other pressures occasionally delay my responding to your inquiries. By the time this column is published, I should be pretty much caught up. If you have been waiting for my response for more than a month or so, feel free to drop me a line, I may not have received the original request.

Work is progressing on setting up a RTTY Loop Home Page on the web. Stay tuned, by the time this column is published it may well be online. Try one of the search engines and see, you might be surprised. In the meantime, the RTTY Loop Software Collection continues to grow. Get the latest list by sending a stamped, self-addressed envelope to the address at the top of the column, or by E-mail to me on America Online (MarcWA3AJR), CompuServe (75036,2501), or via the Internet (marcwa3ajr@aol.com). Then again, if you're lucky, maybe you'll be able to download it from a home page yourself! 73

AMATEUR TELEVISION



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Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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Mail Call!

This month, I'd like to devote the column to answering some questions. Keep those letters coming, folks, but please don't include SASEs; I just can't answer letters personally. Those relevant to the column will be discussed here in the magazine. Here goes:

Dear Kaboom

I recently bought a Radio Shack DX 390 receiver and am now thinking about greater involvement in ham radio. I was excited by your article in which you discussed how computers can be integrated into one's shack. I have a Mac Plus with 4 Megs of RAM. How are computers actually used in ham radio, and what kind of software is available?

Getting My Feet Wet

Dear Wet Feet,

The computer has loomed as the greatest advance in ham radio since sideband and FM came along. How do we actually use computers? Lots of ways! They depend, though, on what facets of ham radio intrigue you. You mentioned you were interested in CW and packet. Packet is, of course, a computer mode right from the word "go." In packet, you can use your computer as a terminal for a separate hardware TNC (terminal node controller—the thing that actually makes and decodes packets), or you can save some money and use the computer as the TNC itself. That's how I do it here, because it saves me the cost of a TNC. Several "software TNC" programs which let you do that are available for the PC, and there's at least one for the Mac. Some of the PC programs are Baycom, Soft TNC, and Poor Man's Packet.

[See "Packet on the Mac," in the October '92 issue of 73. In the article, KD6CMT mentions a Contol Panel called SoftKiss which emulates a TNC in KISS mode. KD6CMT suggests using it in connection with NET/Mac, available through America Online and other online services. Reprints of the article are available for $3.00.—ed.]

Using a computer as a TNC requires adding a small modem. You can buy one for about $50 (considerably less than the price of a hardware TNC), or you can build one, which will be a nice introduction to the technical side of the hobby. I built mine for about $20, and it works fine.

As for CW, there's all kinds of public-domain software that will help you. You can get study courses with audible practice drills. You can also get programs which will actually key your rig and send CW, and some can even receive it pretty well, showing the decoded characters in plain language on your screen! Truthfully, though, CW is not the most machine-friendly mode; if you practice, you can learn to receive Morse more accurately than a computer can. Besides, it keeps your skill up. I do have both transmit and receive on my CW program, but I never use the receive. Still, the transmit function saves a lot of wear and tear on my arm, and lets me send better code than I could with my iambic keyer. It's not as much fun, though.

If you get into contesting, logging programs can help you avoid dupes (duplicate contacts with the same station). And, when you're done, you can have the machine print out your logs, ready for sending in for your awards. I don't care for contesting, so I don't use anything like that. But, many noncontesting hams still like logging programs, simply because they make it easy to keep track of contacts. It's quite nice to answer a CQ ("calling anybody") and call up notes regarding the last contact with the same station. The other ham will sure be surprised when you say, "Hi, Bill, how's your dog's arthritis these days?"

If you get a CD-ROM drive for your Mac, you can install a callbook database that'll let you look other operators up by their callsigns. Especially if you want to QSL (exchange reception report cards), that

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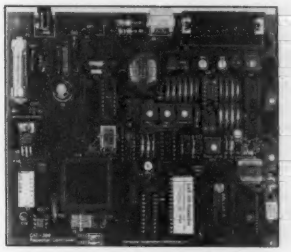

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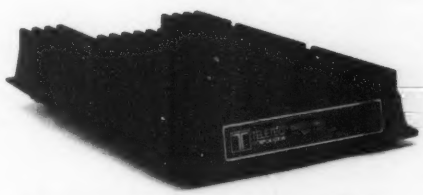

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Dear Kaboom,

The schematic in your article for the Kenwood MC-85 microphone modification did not show the resistor numbers for the 22k and 4.7k resistors. Also missing is the capacitor number for the cap between IC1 pin 2 and the 22k resistor. I'd like to modify my mike to work like yours, but I can't figure out the conversion without those numbers. Can you help?

Missing Info

Dear Missing,

Sorry about that! Somehow, those numbers got removed from the diagram. Here they are: The 22k is R9, and is connected between the wiper of the compression control (VR2) and IC1 pin 6. The 4.7k is R23, and is connected between one end of the same control and ground. And, the 3.3 µF cap is C8, and is connected between IC1 pins 2 and 6. Hope that helps.

Dear Kaboom,

I've been off the air for months, due to a failure of the MRF 485 driver transistors in my Kenwood TS-930. I was told that Motorola no longer makes these transistors. I tried a pair of NTE 236 transistors, which are listed as replacements, but they promptly failed. A Kenwood technician told me that the company does have a replacement transistor, but he no longer does these repairs. Also, there are other modifications necessary. Is there a retrofit?

Unwillingly Silent

Dear Silent,

My ECG cross reference lists these as ECG 236. I haven't heard about the retrofit problem, but it would pay you to try and get that Kenwood tech to send you the details of the required modification. Probably, it's just the addition of a capacitor or something similar. I suspect, though, that the NTE 236s failed for another reason. Most likely, both they and the original parts blew because something else is wrong. If I had to guess without actually seeing the radio, I'd wonder about your final transistors. Are you sure they're not shorted? Drivers usually don't go when the finals are good, and shorted finals will blow drivers faster than you can hit the "off" switch. Before investing in yet another pair of drivers, check those finals. Also, try RF Parts Company, (619) 744-0900, and see if they have any other replacements for the MRF parts. They carry all kinds of RF power transistors.

Dear Kaboom,

I enjoyed your articles on oscilloscope use. I picked up a scope at the last hamfest, but I don't understand one thing: when I hook my probes to the calibrator terminal, I get a nice square wave as long as the probe is in the X1 position. When I set it to X, though, the wave looks like something from outer space! It has big spikes at the top and bottom which then slope inward gradually to the end of the wave. Did I buy a hamfest nightmare?

Puzzled

Dear Puzzled,

Nope! Your scope is fine. It just watches the X-Files too much! Seriously, though, all that's wrong is a simple adjustment, and you don't even have to open up the case to do it. Take a look at your probe and you'll see a little hole with a screwdriver adjustment slot in it. Usually, it's on the part you hold, but it may also be on the part that plugs into the scope. This adjustment sets the capacitance of the probe when it's in the X10 position. Due to the very high input impedance of about 10 megohms, the amount of capacitance has a great effect on the resulting waveform. Just set the probe to the X10 position, connect it to your calibrator, and adjust the probe's trimcap until the waveform straightens out. You'll find that if you then use that probe on the other channel, you'll have to readjust it; that's how critical that setting is! By the way, that's why calibrators have square waves, instead of just supplying calibrated DC voltages with which to set the channel gain.

Until next time, 73 from KB1UM.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Another Potpourri

Several times a year I clean up my "in box" and take on a few topics that are not worth an entire column, but are of interest to readers because most of the ideas came from questions or comments in my mail box. Which brings up a little housekeeping matter. You can reach me at my post office box (P.O. Box 1099, Falls Church, VA 22041), or by Internet E-mail at carrjj@aol.com

Science Fair Project for a Radio Buff?

One of the topics that I've written about extensively over the past five years is what I call "radio science observing." This coined term refers to radio astronomy, propagation observations, and VLF SID (sudden ionospheric disturbances) hunting. The latter requires a VLF receiver, which can be built using low-cost components. VLF SID hunters look for the effects of solar flares on the ionosphere.

Because the distance between the Earth's surface and the bottom of the D-layer of the ionosphere is only a few wavelengths in the 15 to 30 kHz band, a sudden increase in ionization (as occurs during a flare event) causes that space to act like a waveguide at VLF frequencies. A friend of mine uses a geiger counter to record solar flare events. He looks for sudden increases in background radiation levels. It might be interesting to look for solar flares using both the VLF receiver and the geiger counter, and note what correlations do or do not exist.

If you do not own a VLF receiver, and are not inclined to build one, then you might wish to consider using the shortwave bands. The HF shortwave bands are not the best bet because there is a lot of variation in those bands under the best of circumstances. But you can make some recordings using the apparatus described below.

The trick is to monitor a station that stays on the air most of the time. The National Institutes of Standards and Technology (NIST) radio stations WWV (Colorado) and WWVH (Hawaii) are pretty good bets. Try monitoring the 5, 10, or 15 MHz signals.

Recordings can be made with either a strip chart recorder (which can be obtained relatively cheaply on the used market), or by using an A/D converter feeding a receiver. Although A/D converters were once expensive toys, one can now buy them relatively reasonably. There are models that will plug into the parallel printer port on the back of your computer (yep, that's what I said...the parallel port). These devices use the four bidirectional handshaking lines to take in the A/D signal. Others are available that will plug directly into the RS-232 serial communications port on the back of the machine. Radio Shack now offers a digital multimeter that contains a computer interface, and the software to drive it. This meter can be used as a data acquisition A/D converter.

Doing radio science observing may seem like a waste of a computer, but today you can buy non-Windows PCs for a song and a heartbeat. I've seen 286 machines sold for $10 by a local hospital that had just upgraded to 486-DX4 machines. The used ads, hamfests, and local used computer stuff stores can sell an '80s vintage PC-XT class machines for $50 to $100, and 286 machines for a bit more. I recently bought a 386-33 machine at a local used computer stuff shop for $200 complete with monitor. So, as you can see, setting up a monitoring station need not be terribly expensive.

Fig. 1 shows the circuit needed to obtain a DC signal that is proportional to the signal strength. Of course, if you can get to the receiver's automatic gain control (AGC) signal, then use it. But that's not so easy as it was when I was a Novice, so many readers will want to opt for the circuit shown in Fig. 1.

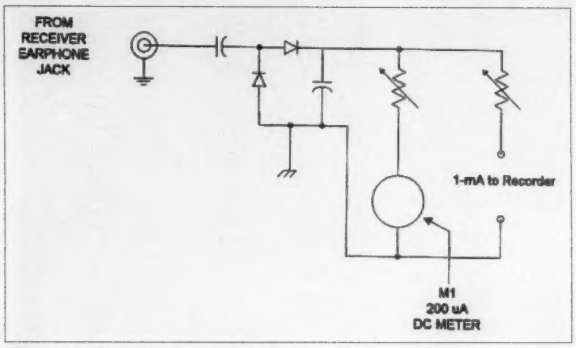

Fig. 1. Audio-to-DC converter for recording signal levels.

This circuit has two parts: a rectifier and an integrator. The rectifier is a voltage doubler type that uses two capacitors and two diodes. The capacitors are each 10 µF units (the straight line side being positive), while the diodes are 1N60 germanium signal diodes. That may surprise you in this silicon era, but those 1950-type diodes are preferred in this application because of the lower voltage drop (0.2-0.3 volts rather than 0.6-0.7 volts) compared to silicon diodes. Radio Shack and other sources still offer 1N34 and 1N60 diodes, usually in a blister pack of about a gozillion diodes for a few bucks.

The integrator produces an output that is the time average of the input signal, so it tends to smooth out very short variations in the signal (e.g., noise spikes), leaving the signal strength variation component. There are actually two methods of "integrating" this signal in this circuit. First, the action of the output filter capacitor, which is also part of the voltage doubler circuit, tends to smooth variations. The second factor is the inertia of the meter movement and the recorder pen assembly.

Levels to the meter and (if you use it) the 1-mA recorder assembly can be controlled with potentiometers. I found that signals' levels are generally sufficient to use nearly any potentiometer from 10k to 100k. In my case, I had a pair of likely 25k linear taper potentiometers, so I pressed them into service.

By the way, if you or some youngster you know is busy with the science fair activity in their school, then you might want to provide them with a copy of my book *The Art of Science* ($19.95, HighText Publications, P.O. Box 1489, Solana Beach, CA 92075; 1-800-247-6553). The chapter on winning science fairs is worth the price of the book alone. Besides, the rest of the book will tell them how to do science and how to handle data.

Bill Orr W6SAI, whom any honest technical writer today will recognize as the guru of gurus, was extremely complimentary in a review of the book in another ham magazine. He was especially enthusiastic about the chapter titled "Counterfeits of Truth," which deals with the logical fallacies. If you have any interest at all in intellectual honesty, then you might want to bone up on the fallacies...and compare with the news media and our politicians.

Low-Pass Filters

A low-pass filter (Fig. 2) is needed by nearly all ham operators who use the HF bands. Harmonic energy from our transmitters will clobber other services, notably television and FM broadcast radio bands (those frequencies that are harmonically related to the ham band frequencies). For transmitter harmonic suppression we would usually want to simply buy a 300-watt or 2,000-watt low-pass filter and be done with it. Those filters have a cut-off frequency between 30 and 40 MHz, so offer a substantial amount of attenuation in the 54-MHz, and up, band occupied by the television stations.

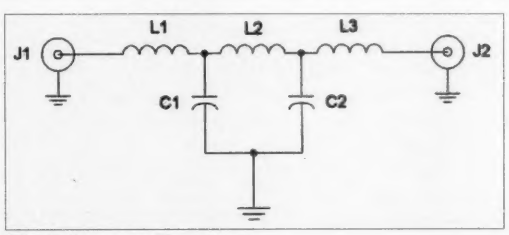

Fig. 2. Low-pass filter circuit.

But what do you do if you want to make a filter for another frequency? For example, suppose you wanted to build a 3-kHz audio filter for use as at the input of the speech amplifier in a transmitter, or at the output of a direct conversion receiver. Well, you build a circuit such as Fig. 2. One way to design your own filter is to look for a "normalized" design, and then frequency scale it. Such filters will show the values for some frequency such as 1 Hz, 1 kHz, or 1 MHz, and then you scale it by dividing the printed component values by the actual 3 dB cut-off frequency you want. That's the way my "FilterMaker" software works. Crude, but you get results.

But what do you do if you don't want a 50-ohm filter? Most of the tables published are for filters that have 50-ohm input and output impedances, which is the standard for RF systems. But in those audio cases mentioned above you might prefer to use 1000 ohms rather than 50 ohms. Also, if you design circuits for the NE-602 chip, you can avoid the use of impedance transformers at the input and output terminals (pins 1/2 and 4/5, respectively) if you go ahead and design the filters for the 1,500-ohm impedance offered by the NE-602 device, rather than 50 ohms.

The 1996 edition of *The ARRL Handbook for Radio Amateurs* holds the solution for you. On page 16.6, the circuits for both capacitor input and inductor input low-pass filters are shown, along with the table for the 1 radian/second, 1-ohm capacitor and inductor values. You can use the equations shown in the article to calculate the values needed for the specific frequency and input/output impedances that you need for your application.

The *ARRL Handbook* has a software diskette accompanying it which makes the calculations a little less tiresome for those for whom a first course in high school algebra was more traumatic than using up a little hard drive space.

It came as a bit of a shock when I ordered the *Handbook*. It's been a couple years since I bought a copy, so I was a little taken aback by the $38 price tag. That's more than ten times the price I paid for my first *ARRL Handbook*...which dates me a bit, doesn't it??? You can get the *ARRL Handbook* from local ham stores or from the Uncle Wayne's Bookshelf (see ads in this magazine). 73

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Energizing Experiments

There are lots of obvious good reasons for including a unit on energy in your ham radio curriculum. While lining up my guest speakers for my classroom this term, I decided to invite a spokesperson from our local electric utility, Con Edison. Guest speakers are always a good idea. They bring a change of pace and face for the youngsters, or to whomever your daily audience is. We wound up having several assembly programs being given so that other children besides the ham radio students could benefit from the visit. Here are some of the experiments the children seemed to enjoy the most.

All of us know that energy is a big part of our lives. Scientists define energy as the ability to do work. There are many forms of energy; for example, there are heat, light, electricity, movement of air, water, and machines, and gravity (the earth's pull). There are many sources of energy; for example, there are fossil fuels, hydropower, nuclear power, and solar power. Sheets of paper were distributed for the students to list the ways in which energy makes their lives better. It was pointed out that some energy sources are limited and costly. That's why conserving energy is so important. After the experiments were completed, the children were asked to add to the list they had made.

The first experiment dealt with conduction. The materials needed are: hot water, shallow pan, metal spoon, wooden spoon, plastic spoon, and a glass rod or tube.

Background:

Heat is an important form of energy in the home. Heat is "molecules in motion." Molecules are particles that are too small to see with the eye. All things are made of molecules. They move back and forth slowly at cool temperatures—faster at warmer temperatures. Heat can move by conduction—heat passing directly from one thing to another through touch. Convection is when something heats air (through conduction), which then rises, carrying the heat elsewhere. Radiation is invisible "heat rays" which carry heat away from something. (No touching of objects or movements of air is needed.)

Homes, schools and other buildings lose heat in cold weather, and gain heat in hot weather by conduction. Heat is "conducted" through walls, doors, windows, etc. In this experiment you'll "feel" conduction at work.

Many spin-off lessons come after a guest speaker has visited a ham radio classroom. Here's Kristy, 8th grade.

Procedure:

1. Pour about 1 inch of water in the pan.
2. Place the spoons and the glass rod or tube in the hot water. Which object do you think will become the warmest?
3. After 2 minutes, remove the objects from the water. Which one feels the warmest? Which one feels the coolest? Children were asked to explain why on their papers.

This was a really simple experiment designed for lower grades. Of course it can be adapted for older classes accordingly.

Hands-on experiments can be "energizing." This is Mohammed, 7th grade.

How To Figure Electricity Costs

The next activity led to several spin-off lessons in math and science. "How To Figure Electricity Costs" brought us many favorable comments from the parents. Materials needed: classroom lighting information (wattage and number of bulbs in the classroom).

Electricity is a form of energy used widely in homes, schools, and other buildings. Choice and use of lighting and appliances affect electricity costs. This experiment will give you a rough idea of how electricity costs are determined.

Procedure:

1. Find out how many light bulbs are used to light your classroom.
2. Find out how many watts of electricity each bulb uses. (More watts means more electricity is being used.)
3. Total the watts. Be sure to include the watts for each bulb.
4. Divide the total by 1000.
5. Multiply your answer by the average number of hours the bulbs are left on during each school day.
6. Multiply your answer by the number of school days in the year. This will tell you roughly the number of "kilowatt-hours" of electricity the lights will use in the school year.

If each kilowatt-hour costs 10 cents, about how much does it cost to light your classroom for the year? Can you think of two ways to cut lighting costs in school and at home?

The students enjoyed running all over the classroom, jotting down the wattage information. More importantly, it made them aware that there is a real cost to consumption of electricity. 73

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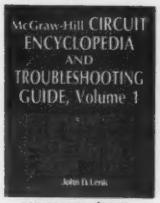

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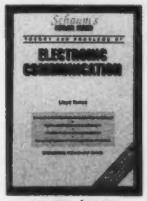

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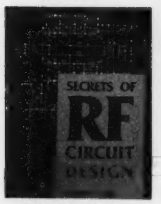

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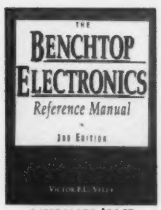

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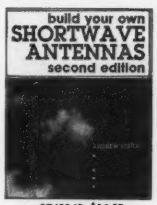

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QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
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Tattooing Yaks

Well, another new year. It's a perfect time to start new projects, and plunge into the unknown. John N8ZXB and Scott N8JSK have taken up tattooing Yaks. A rewarding and highly satisfying hobby—as Scott calls it.

I am not into Yaks, but I do like to play with digital panel meters. In the past, I've mentioned the D1 International DPM5035L as a rather diverse DPM. So, to start out the new year, I'll show you what I've been doing with this meter.

Instead of displaying a voltage obtained from a power source, I've been trying to marry the DPM to a microstrip RF pickup. Up to a certain point, I've been making some progress. Here's the basic idea.

The first thing required is some way of picking off a small amount of RF coming out of our rig. I have been working on several methods, but the stripline seems to work best for me. In fact, my first attempt was in using a defunct CB SWR meter. It had the proper power capacity and the meter had a microstrip already in place. Instead of using PC board copper traces for the actual micro lines, the CB SWR meter used two large copper wires placed in parallel to a single conductor carrying the RF from one connector to the other. It required only a few cuts with the side cutters to remove the unwanted parts. I kept the metal case and added some .001 feedthrough capacitors between the RF section and the digital section.

The diodes used in the original meter were 1N914s. I replaced them with two hand-selected 1N34As. Better diodes are available for this purpose, but I had those guys in hand.

The DPM has a input impedance of over 100 megohms, so loading of the sensor would not be a problem. A two-position switch allowed me to select either the forward RF position or the reflected power position. The meter will not read out SWR, but rather the voltage generated by the forward RF and the reflected voltage caused by any standing waves on the feedline and antenna. To read the actual SWR, a graph would need to be constructed to show the voltage generated by the reflected RF. Of course, the voltage would only be correct at a specific RF output. This is something I have not done. Common sense should instantly tell you the higher the reflected voltage the higher the SWR is on the antenna system.

Problems

Even with an input of 200 mV, the resulting voltage developed by my QRP rig, did not generate enough for a large reading. The reflected reading was even weaker, as it should be.

Looking back, the microstrip is probably not the best thing to use at HF frequencies. Instead a toroid pickup would be better. I could modify the transformer's secondary to increase the resulting voltage generated by the RF passing though the core. I also figured the toroid would be more frequency tolerant.

I ended up using an RF pickup from a an old project I had laying around. I used one of many classic RF sensor projects, many of which are in the *ARRL Handbook*. My pickup will generate both the forward and reflected voltage generated by the RF flowing through it. Everything goes inside a deep drawn aluminum box. All leads leaving the box go through .001 feedthrough capacitors, which I might add, are getting harder to come by.

Once the RF sensor had been built, the next step is to increase the voltage developed by the sensor to a usable level needed by the DPM. To do that, I used an op-amp as a voltage amplifier.

Having spent most of a Saturday night working on the the voltage amplifier, I found that the popular 741 op amp did not provide a low enough offset with no signal. So, a LTC1001 op amp by Linear Technologies was put into use. An OP-07 op amp may also be used, but are much harder to come by. Digi-Key stocks the LTC 1001. The LTC1001 is about $2 a pop.

Instead of sweating blood trying to come up with a dual-voltage power supply, I cheated and used two 9-volt transistor batteries. A third battery is used to power the DPM. This DPM must have its own power source. A junk box 3PDT switch is used to turn off the project. If you don't happen to have a 3PDT switch, just leave the DPM on as it should operate for the shelf life of the battery. That's not the case with the op amp circuit.

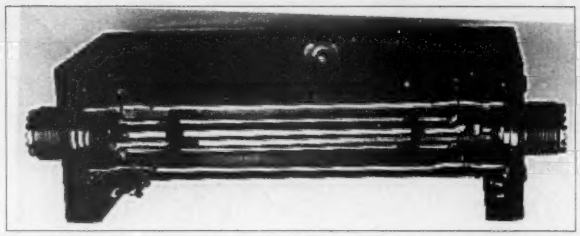


Photo A. Michael Bryce digital panel meter with microstrip RF pickup.

Projects

In Photo A, you'll see the final result of my work. Again, let me state this is *not* a finished project. There is enough information for you to pick up where I have left off. This is not the last word in a digital SWR meter by any means.

I have also tried to add the second circuit to the DPM. Rather than reading the voltage produced by the RF sensor, I tried to make a digital field strength meter. In its simplest form, the meter will display the resulting voltage developed by the detector. Again, an op amp is used to up the voltage to a more suitable level.

Notice, the field strength meter has no tuned circuits. In fact, it has a response from DC to light. By adding some tuned circuits, one should be able to sniff out RF on a very narrow frequency range. If you like twisting knobs and dials, then insert your tuned circuit before the detector and the antenna. Use shielded coils to prevent unwanted pickup from coil to coil. Digi-Key stocks a large assortment of RF coils in their catalog. A plastic AM broadcast 365 pF variable capacitor from a defunct transistor radio would make an ideal capacitor to tune the circuits into resonance while keeping the size of the field strength meter down.

There is still one more project I wanted to try with the digital meter but have not had the time. I wanted to measure the voltage developed across a dummy load and then display the result. In theory, it should work. In Fig. 1, a simple RF detector, will convert

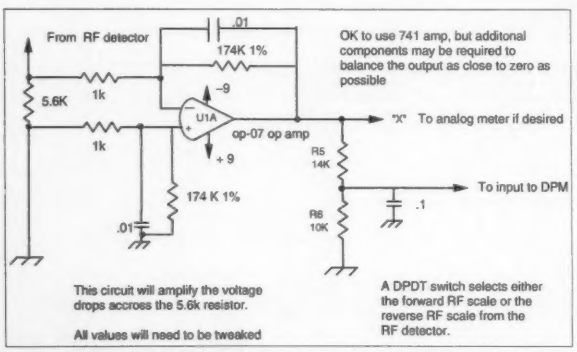

From RF detector
.01
174K 1%
OK to use 741 amp, but additonal components may be required to balance the output as close to zero as possible
5.6K
1k
-9
U1A
op-07 op amp
+9
"X" To analog meter if desired
1k
R5
14K
To input to DPM
174 K 1%
.01
.1
R6
10K
This circuit will amplify the voltage drops accross the 5.6k resistor.
All values will need to be tweaked
A DPDT switch selects either the forward RF scale or the reverse RF scale from the RF detector.

Fig.1. Schematic of the DPM.

Welcome Newcomers

Wayne Green W2NSD/1

When I saw the FCC's license figures for the last 10 years I could see that we'd had a substantial increase in Techs, but it wasn't until I drew the graph you see here that I grasped the full extent of what has actually happened. Check it out and let the message sink in.

The graph explains several things: (1) Why hamfest attendance has dropped so much in the last few years; (2) Why our ham dealers and manufacturers are really hurting for sales; (3) Why our ham bands seem less crowded than they did 30 years ago.

The General Class license numbers have increased at about 1.1% per year over the last 10 years. But when you consider that the FCC admits that over 40% of the old licensees are not renewing when their tickets expire, that looks like a possible loss of 4% per year! The obvious fact is that the no-code Techs, with pitifully few exceptions, are just not interested in upgrading. Our repeater system is much better than the 40 channels of CB, and that's all they seem to want in life.

And that means that *Radio Fun* has failed in its mission. We haven't been able to sell the current newcomers on the great fun amateur radio provides via satellites, building kits, packet, ATV, SSTV, RTTY, DXing, DXpeditions, foxhunting, ham clubs, and so on. I don't run any of my businesses just to make money. They all have a mission, so I'm discontinuing the publication of *Radio Fun*. Maybe this will allow me to spend more time pushing cold fusion, which has a far greater potential for benefiting the world.

Can anything be done to blast these ex-CBers off 2m and into General tickets? I'd like to see some clubs make an effort to (a) get these guys to come to club meetings; (b) provide them with upgrading classes; (c) send me photos of their graduating classes, along with stories on how they did it.

"Get on from there and work 10,000 J's in a week, and you'll see what good operating sounds like."

We can't win this by hassling the Techs. Ridicule won't work either. What we have to do is get them interested enough in what the HF bands have to offer to get them to go for a General or Advanced ticket. That's why I've been harping about our setting up crossband repeaters, making club meetings more fun, getting some zing into the club newsletters with reports on what hot DX some members have worked recently, and anything else exciting that the members have been doing.

I get a lot of club newsletters, but I don't recall seeing one with a request from the editor for the members to write about anything exciting they've done in the hobby. Amateur radio has provided a lifetime of excitement for me, which I try to share with you. If I can get on the air from South Yemen, so can you. It didn't cost me anything because I kept my eyes open and grabbed the opportunity when it turned up. I keep asking you not to just enjoy life's merry-go-round, but reach out for that brass ring. You can get it, but only if you really reach.

When I started *73* I put every nickel I had into the first issue. I didn't start out rich. I wasn't a great student in school. Heck, I just barely made it with C's. It was ham radio that pushed me to go to a technical university. It was ham radio that got me into the Navy as an electronic technician. Later a RTTY chum got me a job on a Guggenheim grant, working on a color organ. And another RTTYer got me a job as the head of the Music Research Foundation. My hamming got me into broadcasting as an engineer-announcer, and then into TV as an engineer, cameraman, then a producer-director. It was RTTY that got me into publishing.

We know that the key to making money lies in technology, and we also know that hamming makes it fun to learn about electronics. As transportation costs drop and communications systems improve and get cheaper, unskilled people in America will be more in direct competition with unskilled workers in the lowest-wage countries of the world. So we're going to see more and more of a difference between what educated and ignorant people earn.

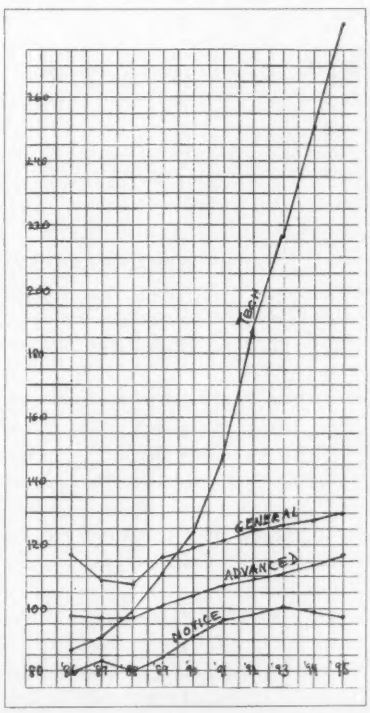
I do get upset over the bleeding heart liberals taking my money and giving it to people who spurned the free education they were offered, thereby guaranteeing themselves poverty unless they go into crime. Grumble.

I want to read in club newsletters about the clubs descending on their local schools like locusts and getting the kids interested in hamming. I want to see them never-say-die on getting the new Techs in their area to upgrade.

I'd hoped that I could make a difference with *Radio Fun*. The hams I did get to subscribe liked it a lot. I think we had one of the highest percentages of renewals in publishing history. But, as I explained, I've never had any interest in doing something just because it makes money. If it isn't going to somehow be a benefit to mankind, the heck with it.

Look, the ARRL obviously isn't going to do anything about this, and I've failed, so it's all up to you. Start seeing what you can do to get these Techs to upgrade and have some fun with us on the low bands. Get 'em on packet. satellites, or maybe a DXpedition to South Yemen. It's been a while since I operated from there. Or perhaps New Caledonia, where the local hams are very friendly and will lend you their stations, so you don't even have to carry your rig and antennas along. Get on from there and work 10,000 J's in a week, and you'll see what good operating sounds like. 73

73 is looking for ham related photos for use on the cover. Call 800-274-7373.



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the RF across the dummy load and then output the result as a DC voltage proportional to the input. The old Heathkit Cantenna has such a circuit built inside a small box mounted on the dummy load lid. As a matter of fact, I plugged into the output jack of my Cantenna and was able to display a reading on the DPM. Again, a graph could be made to compute the number displayed on the DPM into something more useful. Or, if you wanted to get really mad and wild, a small embedded microprocessor such as the PIC 16X series could be programed to convert the incoming voltage into something really useful on a LCD display

For those of you who want to experiment with the digital SWR meter, I have some of the D1 International DPMs in stock. They're $30, and that includes first class shipping. Send to my attention at the address at the top of the column.

Major Project Plus New Rig

As I write this, I am about to undertake a major project—cleaning off my work bench! For sitting on a table in the next room is a TACP1 by S&S Engineering. This rig is the first synthesized QRP transceiver to come from S&S Engineering utilizing a tuning knob for frequency selection. This is the second version of the TACP1. The first model was available only on the 80 meter band. There is now a TACP1 for 40 meters, the bread and button of most QRPers. Stay tuned for a full-blown review of this exciting new rig. 73

Communications Simplified, Part 1

Peter A. Stark K2OAW
PO Box 209
Mt. Kisco NY 10549

If you're into ham radio, then you are already into electronic communications as well. But if you are a beginner, or if you've limited yourself to contesting or chatting on your local repeater, you've probably missed out on a lot of the more interesting technical parts of communications. This series of articles will try to bridge that gap, but in a simple (and hopefully interesting) way.

These articles are the result of a community college course I have been teaching for some years. Since I haven't been able to find just the right textbook for my course, I've decided to write my own course notes. Eventually, these notes will become a textbook, but for now you're looking at just the notes.

But don't be scared by the idea that this comes from a college course—it isn't as complex as you think. First of all, I teach a survey course. That means that it's an introduction to communications for students who haven't taken any other communications courses before. So it starts fairly simply, and doesn't assume a lot of previous knowledge. In those areas where it assumes some knowledge from a prior course, or where it seemed like a good idea to discuss some related topic, I've inserted what I call "detours"—short discussions that temporarily break away from the main subject.

Second, I teach a survey course that tries to cover a big area in just one semester. That means that there isn't time to go into tremendous depth on any one topic. Hence, we have to stay fairly simple at all times. The course has a lot of descriptions and pictures, and almost no math.

Third, this is a community college course in the second year of a technical program. It's intended for students who will become technicians, not engineers or mathematicians.

Finally, Wayne has made me promise not to show off with fancy formulas and theorems, and to add a little sugar to make the material go down easier. (I guess that means I have to crack a bad joke now and then, such as "What do you get from a Mafioso college professor? An offer you can't understand!")

But before I start off, let me add a little fine print for the benefit of the many readers who probably know a lot more about this subject than I do. Please keep in mind that these articles are intended for beginners. As such, I will often provide explanations that may seem a little (maybe *very*) simple-minded to you. While my explanations will not be *wrong*, they may be very *incomplete*. Please don't barrage me with long treatises and reprints from other texts and journals if I've omitted or simplified too much (but do let me know if I say something that isn't true).

So let's get started.

Communications

Communications is simply the moving of information from one place to another.

An English teacher thinks of communications as the process of writing or speaking words, which tell your reader (or listener) something you want him or her to know. There is even something called mass communications, which is sort of like journalism, but for TV, radio, and film. In this course, on the other hand, we think of communications more as the electronic process and equipment needed to send information over long distances.

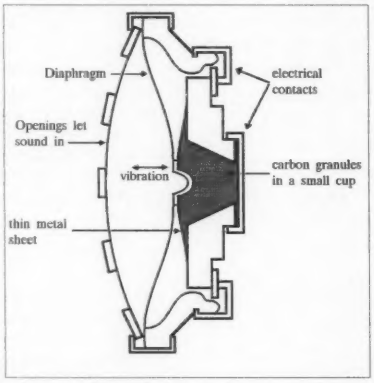

Fig. 1. Telephone-type carbon microphone.

For our purposes, we are interested in three aspects of communications:

- What is being sent? In other words, what kind of information are we sending; is it sound, pictures, or perhaps computer data?
- Through what is it being sent? That is, what is the *medium* through which it goes—wire, radio waves, sound, light, fiberoptics?
- How is it being sent? All by itself as in a telephone wire, or combined with other signals? Analog or digital?

It would be nice to be able to look at each one of these questions separately. Unfortunately, they all interact, and so our discussion will have to flit back and forth occasionally. Still, let's try to start with an orderly approach.

Let's start off with what is being sent. The information you send can be sound, video (pictures), or digital information. Let's look at each in turn.

Sound

Sound is simply the vibration of air. When we speak, our vocal cords vibrate the air coming out; the sound travels through the air until it vibrates the ear drum in someone's ear, which eventually winds up in sending nerve signals to that person's brain.

In electronics, a microphone is used to convert the air vibrations into an electrical signal. The air vibrations move a thin metal or plastic plate

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(called a *diaphragm*) inside the microphone; a motion-to-electricity converter then converts the motion into an electrical signal. This signal is amplified and somehow sent from one place to another, and then converted back into air vibrations by a loudspeaker. Both the microphone and the loudspeaker (more often just called the speaker) are called *transducers,* a term describing any device that converts energy from one form (such as mechanical vibration of the air) into another (such as an electrical signal). (See Detour 1.)

In simple sounds such as someone whistling, the resulting waveform may be a sine wave; in more complex sounds the waveform may be much more complex as well.

Let's now look at the output of a microphone on an oscilloscope. What you see depends on the sound that the mike is picking up.

Suppose you stand in front of a mike and whistle a pure note into it (making sure to be far enough away so the mike isn't picking up the sound of the air hitting its front). You'd see the signal shown in Fig. 4. This kind of a wave is called a *sine wave* because of its relationship to the sine function from math.

On the other hand, suppose you whistle another note, but this time an octave higher. The word *octave* is a musical term, meaning eight white keys lower on a piano keyboard. This time you'd see the waveform of Fig. 5.

Both of these waves have the same shape, but the second one goes up and down twice as often as the first. In electronic terms, its frequency is twice as high. More on this in a moment.

Now suppose you do the same thing, but this time look at the signal created by the sound of some instrument such as a trumpet, rather than a whistle. Fig. 6 shows the resulting picture.

The sound in Fig. 6 has the same frequency as that in Fig. 5 (since it has the same number of cycles in a given time period), but it looks very different. A musician might say that it has the same *pitch* (that is, it is the same musical note), but different *timbre* (a different sound quality). Some repetitive sounds (like the pure tone of a flute) have a waveform almost like a sine wave; other repetitive sounds (like those from a violin or trumpet) have a waveform possessing a basic frequency, but which looks much more distorted and "kinky" than a sine wave.

The frequency of a note determines the pitch; two different instruments playing the same note have the same frequency. But they sound different because their waveshapes are different. Finally, note that the amplitude of the wave—its height—determines its volume. Quite often the amplitude of the waveform changes with time. For example, when you play a piano note, the amplitude builds up to a maximum fairly quickly when you hit the key, but then gradually decreases as the note dies away.

Note also that only repetitive sounds (like a whistle or the note of a guitar) have a definite frequency; other sounds (like the beat of a drum or the crack of a whip) do not.

Sound normally involves frequencies from about 20 to about 20,000 Hz, but many people cannot hear that entire range. Children often hear up to almost 20,000 Hz; as you get older, you hear fewer and fewer high frequencies.

When you reach 60 or 70 years of age, you will be lucky if you can hear up to 10,000 Hz. On the other hand, many animals (such as bats or dogs) can hear much higher frequencies than humans can.

Fig. 7 shows the frequencies produced by each of the white keys of a piano. For example, if you look at the note labeled "Middle C," you will note that its frequency is 261.6 Hz. If you then go an octave to the higher—counting exactly eight notes to the right—you get to the next C, which is at 523.2 Hz, exactly twice the frequency. The piano has about an eight-octave range, and its frequencies range from about 27 Hz on the left or bass end, up to almost 4,200 Hz at the right or treble end. Fig. 7 also shows the frequencies produced by various other instruments. For example, the trumpet produces notes only in the range from about 160 Hz up to about 890 Hz.

That brings up an interesting question: If the frequencies of musical notes range up to about only 4,200 Hz (and most musical instruments have even less of a range), why do hi-fi equipment manufacturers stress that their equipment goes up to 15,000 or even 20,000 Hz? The answer has to do with harmonics.

Harmonics or Overtones

So far, we've explained that

(1) The frequency of a sound determines its pitch or tone, and two instruments playing the same tone will have the same basic frequency. That basic frequency is called the *fundamental.*

(2) The amplitude of the sound determines its volume.

(3) The waveshape of the sound is what gives it its tone quality. For example, a trumpet or violin can play the same note, but they will have totally different waveforms; that is what makes them sound different.

Consider, for example, a square wave like Fig. 8. What is it that makes this wave different from a sine wave?

Suppose this square wave has a frequency of 1,000 Hz. An interesting thing happens when we send it through some tuned bandpass filters—that is, filters that let through only one frequency. This is shown in Fig. 9.

When the 1,000-Hz square wave is sent through a 1,000-Hz filter, out comes a 1,000-Hz sine wave! Nothing comes out of the 2,000-Hz filter, while a small 3,000-Hz sine wave comes out of the 3,000-Hz filter. What's going on!?! (See Detour 2.)

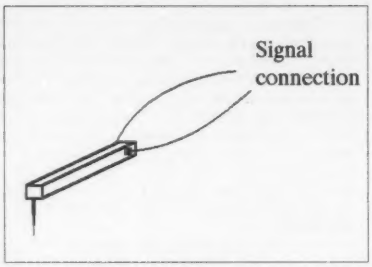

Fig. 2. Simplified crystal phono cartridge.

Returning to Fig. 9, we have three filters all looking at the same original 1,000-Hz square wave. We see three things:

• The 1,000-Hz filter outputs a 1,000-Hz sine wave, so there must have been a 1,000-Hz component in the square wave.

• The 2,000-Hz filter outputs nothing; thus, there was no 2,000-Hz component in the square wave.

• The 3,000-Hz filter is also outputting a signal, and we see that it has three times the frequency of the square wave (there are three times as many cycles in the same amount of space); so it seems to be at 3,000 Hz. Moreover, if we were to measure it carefully, we would see that it is exactly one-third the height of the 1,000-Hz sine wave.

If we had more filters, we would see other frequencies as well. Any filter tuned to an odd multiple of 1,000 Hz would show an output, while any other filter would show nothing coming out at all. For example, if we had a filter tuned to 5,000 Hz, out would come a small 5,000-Hz sine wave, and so on.

We can see from this that a 1,000-Hz square wave consists of a large number of components. The 1,000-Hz sine wave is called the *fundamental,* since it has the same frequency as the original square wave. Each of the other components is an exact multiple of the fundamental; the frequency of the 3,000-Hz signal is exactly three times the fundamental frequency, and is therefore called the *third harmonic;* the 5,000-Hz component has a frequency of five times the fundamental, and is therefore called the fifth harmonic. In other words, a square wave consists of a fundamental sine wave signal (whose frequency is the same as that of the square wave), plus a large number (actually an infinite number) of extra frequencies, each of which is an exact odd multiple of the fundamental. We say that the square wave consists of a fundamental plus an infinite number of odd harmonics.

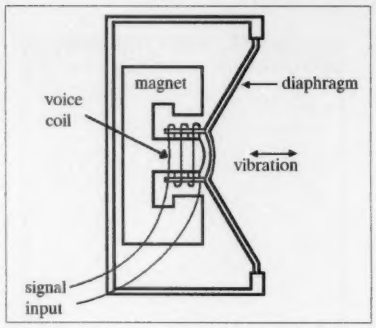

Fig. 3. A telephone-type earphone.

Fig. 10 shows a computer simulation of this situation. It shows a fundamental plus four harmonics (the third and fifth are labeled; the seventh and ninth are not), each of which contributes a little to the output. When they are all added up, we get the wave that looks square shaped, except that its sides don't go straight up and down, and the tops and bottoms are not quite completely flat. The reason it only approximates a square wave is that it has only a limited number of odd harmonics, whereas a perfect square wave requires an infinite number of them.

This is an important concept to understand: The square wave consists of an infinite number of components. Of course, the components have to be just right—they must have the right frequency, the right amplitude, and even the right phase. For the square wave, the rules are fairly simple:

• The harmonics must be exact odd multiples of the fundamental frequency. For example, the 93rd harmonic of a 1,000-Hz fundamental would have to be *exactly* 93,000 Hz.

• Their amplitude must be just right. For example, the third harmonic must be exactly one-third the size of the fundamental; the fifth harmonic must be exactly one-fifth the fundamental's size, and so on, all the way up. Thus the 93rd harmonic would have to be 1/93 the size of the fundamental. This points out that eventually the harmonics get so small that perhaps they can be omitted without making a noticeable difference in the square wave.

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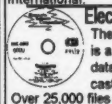

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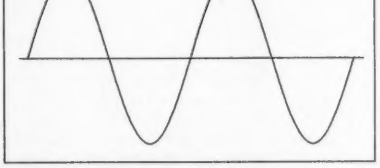

Fig. 4. Waveform of a whistle.

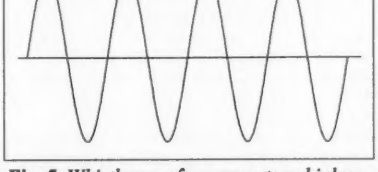

Fig. 5. Whistle waveform an octave higher than that in Fig. 4.

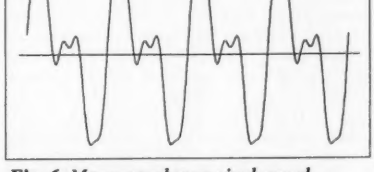

Fig. 6. More complex musical sound.

• Their phase has to be just right. To get the steep rise and fall of the square wave, all of the sine waves making it up have to go up together, and down together, as shown at points *a* and *b* in Fig. 10. If any one of them is out of step, the result will be some wave other than a square wave.

We can extend this concept in two important directions, both of which are critical to understanding many of the circuits in communications:

(1) Just as the square wave consists of a fundamental and harmonics, so *any repetitive waveform consists of a fundamental and harmonics,* although some of these might be missing in special cases. The sine wave is a special case since it has no harmonics at all; the square wave is another, in that only odd harmonics exist, they all rise and fall together, and the harmonics get smaller as their frequency rises. In a more general case, there might be both even and odd harmonics, some harmonics might be large and others small or missing, and they might have all sorts of strange phase relationships. You may have heard of the FFT or Fast Fourier Transform; it is simply a mathematical procedure for finding out what components make up any particular waveform.

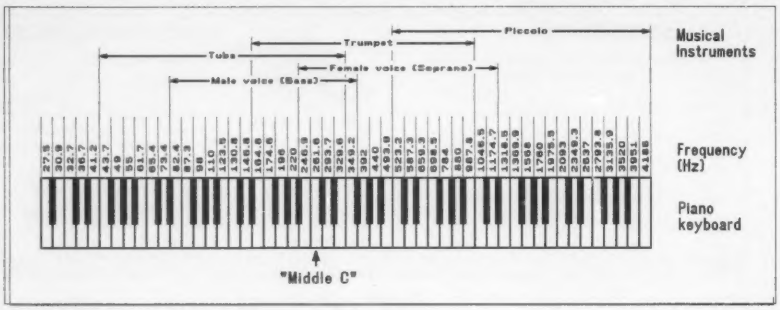

Fig. 7. Frequencies produced by musical instruments.

(2) No matter how you generate that waveform, the harmonics are there even if you don't consciously put them in. For example, one way to generate a square wave is to set up a switch that rapidly switches between a positive and a negative voltage. This setup obviously doesn't put in any sine waves, yet if you look at the square wave with some tuned filters, the fundamental and harmonic sine waves are there.

Let's think about filters again. A filter lets you look for specific frequencies (or colors) in a signal (or in light). But using colored filters to look for specific colors in light is a hit-or-miss proposition if you don't know what to look for; you might need many specific color filters to identify the components in a particular

DETOUR

DETOUR 1

OK, now you see how detours work. Let's detour to talk about transducers. Microphones (also called mikes) come in many different types. Most common is probably the carbon mike, because it is used in every older telephone (the old-fashioned kind, not the newfangled little phones made in the Far East. But not just the real old ones, as in Photo A; more modern ones, too).

Like every microphone, the carbon mike has a diaphragm, which vibrates when hit by a sound wave. The diaphragm in turn moves a thin metal sheet that presses on carbon granules in a small cup. The electrical connection is made to the metal sheet and to the bottom of the cup, as shown in Fig. 1.

The carbon granules are small particles of carbon, which act as a resistance between the cup and the diaphragm. The value of this resistance depends on how closely the granules touch. As the diaphragm vibrates, it alternately squeezes the granules to increase the pressure between them, or releases the pressure. This changes the resistance of the mike in step with the vibrations of the air. The mike is in series with a battery (back in the telephone company's central office, not inside the phone), and thus varies the current in time with the sound. The current variations are converted to voltage variations when the current passes through a resistor or a transformer.

It turns out that a carbon mike has very bad sound quality, but it has one advantage—the voltage variations in the series circuit can be quite large, which means that the electrical signal from the mike can travel long distances without any amplification. This was obviously necessary back in the early days of the telephone, before there were any amplifiers.

Carbon mikes were used in the early days of radio, too, but they were soon replaced by better-sounding mikes.

One inexpensive mike still commonly available is a crystal or ceramic mike. This kind of mike uses a crystal (usually quartz) or ceramic material that is *piezo-electric*. This kind of material is a natural transducer: If you connect a set of terminals to a small block of the crystal or ceramic material, you get a voltage when you squeeze or twist the block; alternatively, the block twists or changes shape if you put an external voltage across it. So it naturally changes mechanical movement into an electrical signal, or vice versa.

Piezo-electric materials have many uses. For example, Fig. 2 shows the idea behind a crystal phonograph cartridge. The needle is attached to a small block of crystal. As the needle rides in the record groove, it twists the crystal, and the two wires attached to the other end generate a voltage proportional to the needle movement. When sufficiently ruggedized, it also works backward. For example, some 40 years ago, Astatic created a recording head that used a crystal to make records. When fed with 50 or 100 volts of audio, the crystal would move a sharp needle and cut a record.

Although crystal cartridges are no longer popular, piezo-electric materials are still often used. One modern application is for lighting a gas flame. When you push a button, a small weight hits a piezo-electric block, which in turn generates several thousand volts. This causes a spark that lights the flame.

In the crystal or ceramic mike, the diaphragm is coupled to the piezo-electric material so that the sound vibrations move the block; this in turn generates an electric voltage that is proportional to the sound signal. The mike can generate a volt or so of audio, though only at a small current.

Crystal and ceramic mikes are somewhat fragile, but back in the days before inexpensive IC amplifiers were available, they were popular because their output didn't need much amplification to be useful. But today's integrated circuits provide lots of cheap gain, so the most popular contemporary mike is the dynamic microphone.

Dynamic mikes work on the same principle as electric generators in power plants or even in your car: When a coil of wire is placed in a changing magnetic field, the coil generates a voltage. This can be done in two ways—either keep the coil stationary and move a nearby magnet, or else keep the magnet stationary and move the coil.

Since the coil is usually lighter and smaller, it's more common to move the coil. In the dynamic mike, the diaphragm is attached to the coil, and the magnet is stationary. When the diaphragm vibrates, the coil moves in relation to the magnet, and thus produces a small voltage.

Dynamic mikes and dynamic earphones have much in common, since the earphone can work as a mike, and the mike can work as an earphone (except that the earphone usually isn't rugged enough to produce much sound). For instance, Fig. 3 shows the earphone from a typical telephone. In this case, an electric current through the coil (which is called the voice coil) produces motion. The *voice coil* is attached to a diaphragm that then vibrates and produces sound. Modern speakers have a similar construction, except that the diaphragm is much larger and is called the *cone*.

As I mentioned above, dynamic mikes and earphones work in both directions. For example, some years ago, after placing a call from a pay phone, I discovered that someone had apparently stolen the mike from the handset. By yelling into the earpiece, I was able to complete my call anyway. But since dynamic mikes (and earphones!) produce much less output than a carbon mike, even with yelling my signal was very hard to hear.

Dynamic mikes can produce very good sound quality, mainly because the mass of the diaphragm and attached coil is very small, and so they easily vibrate in step with the sound wave. Since the vibrations of sound occur very rapidly, a heavy diaphragm cannot move fast enough to accurately reproduce these sound waves. A carbon mike is worse, since it has to move a lot of carbon granules. A crystal or ceramic mike is better, but it still has to apply some force to the piezo-electric material and this increases the mass. A dynamic mike is an even greater improvement because the diaphragm and coil can be very light. The best mike would be one in which there is just a diaphragm, and nothing attached to it at all. There is a form of a dynamic mike, called a *ribbon microphone*, in which the diaphragm is actually a thin strip of foil acting as the coil. But these mikes are very fragile (a strong wind can ruin the foil) and also provide a tiny output, and so they are not very common.

Instead, professional recording studios often use an excellent (though very expensive) mike called a *condenser microphone*. In the condenser mike, the diaphragm acts as one plate of a capacitor. As it moves, the capacitance changes, and an amplifier picks up that change and converts it into a voltage change.

Condenser mikes require a power supply, partially to charge up the capacitor, and partially to power an amplifier right inside the mike. The amplifier is needed because the condenser mike output voltage is tiny, and so it has to be amplified right inside the mike before being sent out the cable. Professional recording studios usually have a 48-volt power supply inside the recording console to supply power to condenser mikes.

The cheap modern version of a condenser mike is the *electret microphone*. These mikes work on the same principle as older condenser mikes, but the diaphragm is made out of a permanently charged semiconductor material that does not need a separate power supply. There is still an amplifier inside the mike, but the amplifier needs only a volt or two to run and so can be powered by a single battery. Electret mikes are not as good as professional condenser mikes (since their diaphragms are heavier), but they are cheap and small. Radio Shack has some electret cartridges for $2; these cartridges are often found inside small cassette recorders. When you buy an actual electret mike, most of its cost is in the case and hardware, since the cartridge inside is often the same $2 cartridge (even cheaper in larger quantities).

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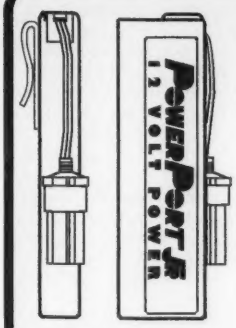

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light source. You can save a lot of time by looking at the light through a prism, which lets you see all the color components at the same time in the form of a rainbow or *spectrum*. The prism acts like a very large number of filters, all working together to check all the colors at the same time. You can then immediately spot whether a given color is in the light, or whether it is missing.

In communications there is an instrument that does the same job. Rather than looking at a signal through filters that look at just one frequency at a time, we can use a *spectrum analyzer* to break down a signal into its components and display them all on a scope screen as a *spectrum* (notice the similarity to the use of the word in referring to a spectrum of color).

The spectrum analyzer measures the frequency components in a signal and plots the voltage of each component against its frequency. For example, if you were to look at a pure 1,000-Hz sine wave on the analyzer, you'd get a picture like Fig. 11.

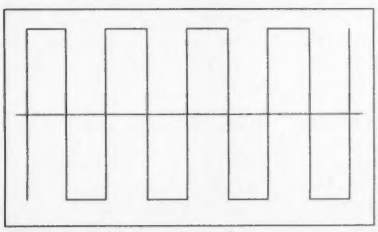

Fig. 8. A square wave.

If you imagine that 0 Hz is on the left of the screen, and each division to the right represents 1,000 Hz, then the "blip" toward the left would be at 1,000 Hz, and (in this case) have a height of 7 divisions. (Ideally, the blip would be just a thin line, but on the spectrum analyzer it is spread out so it looks like a very tall but thin bell.)

Leaving the analyzer at the same setting, Fig. 12 shows the spectrum of a square wave. This time there is a big blip at 1 kHz (I added small numbers at the bottom of the figure to mark off kHz) indicating the fundamental, and progressively smaller blips at 3 kHz, 5 kHz, 7 kHz, and 9 kHz, showing some harmonics. If you examine Fig. 12 carefully,

Continued on page 77

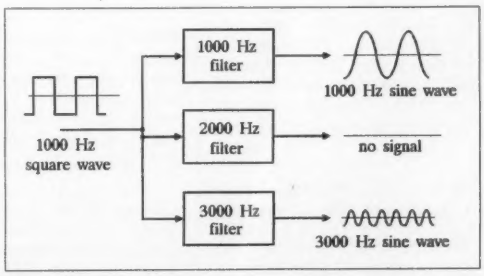

Fig. 9. Separating a square wave into components.

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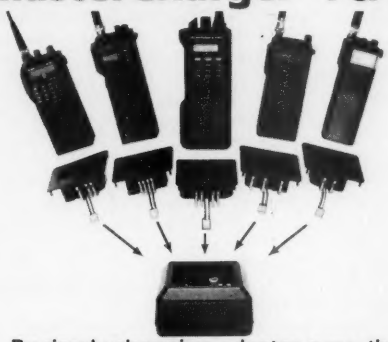

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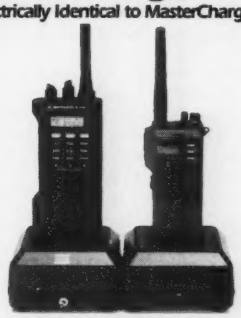

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NEVER SAY DIE

Continued from page 4

CompuServe, Prodigy, bulletin board systems, and so on?

There are almost endless communications services out there. Now, if you, as a bona fide communications expert, can't answer even simple questions about 'em, imagine how confused the average business person is when faced with choices of telephone switches, cellular telephones, teleconferencing, security systems, computer networking, and so on. All this is so far beyond the average person to deal with that you have a tremendous opportunity to make some money—once you know your stuff.

No, you don't know all the answers now, but with your ham background, at least you can understand the questions and you have some clues on where to find the answers. Knowledge is not only power these days, it's money. There are at least ten million small businesses that could be benefited by better communications, security, and computer systems. That's one heck of a market.

How long do you think it would take you to become an expert on pagers, just to pick one field at random? You need to get literature from the manufacturers, dealers, and service companies. You'd want to read a couple books on the subject, subscribe to a magazine. Are we talking six months? One month? A week?

Next you'd want to visit some of the companies involved in the business and talk with them. Find out their problems, what success stories they have, which equipment they think works best, and so on. Couple of months in your spare time?

Now that you have a good understanding of the technology, the players, and have the contacts you need, what should you do next? My recommendation would be to sit down at your computer and write a brief handbook on the subject—maybe 32 pages. Write it for the nontechnical average business person. Explain the benefits this service provides and show how the costs are small compared to the benefits. You can make the handbook look professional by printing it on a laser printer. The first hundred copies can be made on a copy machine. That's the way I do all of my booklets until the demand gets out of hand and practicality forces me to use a commercial print shop.

This will provide you with some sales literature for your new communications consulting service. With your name as the author, this certifies that you are an expert. It's like a Ph.D. Now you're in a position to send letters to local businesses offering the first phase of your communications consulting services.

Once you know your stuff on pagers it's time to pick the next business you're going to learn. If you've made any efforts toward selling your pager expertise, by now you'll know what questions business people are asking about other communications services. You might tackle fax-modems next.

Same deal. Get the literature. Read the books. Subscribe to the magazines in the field. Talk with the manufacturers, dealers, and services. Help some friends for free, learning on their money. It's always best to use other people's money (OPM) as much as possible when you are learning your skills and building your knowledge base.

Within a year, if you make any kind of an effort at all, you'll be Mr. Communications in your town, and you'll have dozens of small businesses turning to you for solutions. In the communications business you make money on sales, on installations, and on service. Great business. All communications equipment breaks, so the service business is wonderful. And computers, being the most complicated of all, break the most often. Plus there are viri, incompatible software, static electricity, errant magnets, and so on, to help keep you living comfortably.

Oh yes, it won't hurt to become an expert on magnetic fields and go around with your gaussmeter and help people avoid possibly harmful fields. There'll be a very inexpensive gaussmeter on the market soon that does a wonderful job.

And when your customers want to know whether cellular telephones are harmful or not, you'll know the answer and be able to give them a reprint of an article from *73* on the subject.

There's no reason for any ham with even the slightest amount of gumption not to be living in comfort and have as big a ham station as he wants. Or she, as a balm to militant feminists. Gumption. Guts. The will to make a change in your daily routine. The will to turn off the TV, to *not* go to that ball game, to *not* read that newspaper. The will to use your time to invest in yourself and a better future.

Expert Help Needed

If you are already an expert on any phase of communications, how about writing an article for possible publication in *73* to help newcomers to the field? They need to know the suppliers, publications, have a list of recommended books, how distribution works, what frequencies and services are available and their average cost—things like that.

If we can get a series of articles to help *73* readers come up to speed on business communications services, that'll help a bunch of hams build some spare-time income, and maybe be able to take their new consulting businesses full time as entrepreneurs. So what's out there in BBS software? In security products and services? In video conferencing? Satellite services?

Or are you happy with your old ham gear and not having enough money to comfortably buy a subscription to *73?* Tsk. The money is out there in great big gobs, you just have to make a little effort to grab it. And that means turning off the ball games and doing some homework instead. Get off the couch, put down that can of beer, brush off the pretzel crumbs, and get cracking. I don't care if you're 20 or 70, you can learn new things and it'll be some of the best fun you've ever had. Heck, I'm 73 now and I'm tackling a whole new branch of physics—one which not even the best scientists in the world understand yet—cold fusion. Now *that's* exciting.

I'd love to know more about communications, so I'll be reading any articles submitted for my own edification and well as yours. That means they've got to be simple enough so I can understand them.

CW Fiends Alert

Just because I am anxious for us to build up our ranks before the FCC wises up and closes us down as no longer relevant, some code-loving readers have misinterpreted this as Wayne hating CW. Well, actually, I really do hate CW, but that has nothing whatever to do with my efforts to get the code test the hell out of the licensing exam system. No, the reason I have always hated the code is because my beloved government made it mandatory.

I have an obviously twisted gene which just naturally rebels against anything mandatory. I wouldn't have lasted long as a slave. Hmm, I wonder if the blacks may have a problem with the natural selection process working over several generations as slaves, thus tending to make them more inclined to be followers than leaders? Sure, call me racist, if that makes you feel superior. But it makes sense, and I haven't ever seen anyone come up with that concept before. And it could help explain a lot of what's been going on.

If the code had been voluntary, I'll bet I'd have been a whiz at it and had a ball. It's always looked like fun, but I'd be damned if I was going to be forced to do something. The Navy and I had some problems with this concept, with them being used to the "How high?" response to a command to jump.

Anyway, for those of you who have had no problem with knuckling under to the government, there's a great little CW magazine you've probably been missing. *Morsum Magnificat* is in its fourth year and is running around 48 pages a month. Subscriptions are $26.50 via airmail from the UK. Make checks out to Wise Owl, 4314 West 238th Street, Torrance CA 90505-4509. Credit cards via 310-375-6258. You'll love the stories and photos of old-time keys.

Once the FCC gets rid of the code tests I'll buy a key and start catching up on the fun I've missed. I might even organize code certificates which can be awarded at hamfests. I started my ineffective campaign to get rid of the code tests in 1958. Will I have made any headway when the 40th anniversary of my windmill tilt arrives? Probably not.

MARS News

Effective October '96, CW will no longer be used on any MARS circuits, according to a recent Department of Defense order. "It is recognized that CW can no longer compete with the rapid advancements in radio technology. Therefore, CW is to be retired from use within the DOD MARS." Newer modes such as packet, AMTOR, and PACTOR have also replaced RTTY.

Digital Camcorder

Digital video has been promised for some time. Well, it's finally arrived, via Panasonic. The camcorder provides 500 lines, which is 50% better than live TV broadcasts. It also records CD-quality audio, and all on a cassette which is 1/12th the size of a VHS cassette. Since the data is digital, it'll be able to connect to computers.

The cassettes use 6.35 mm tape and a 60-minute tape will store 12.5 gigabytes of information. That would take about 8,700 floppies, so this tape should have lots of computer applications for storage and backup. The 60-minute tape is expected to sell for about $14. The camera will be a little more, on the order of $4,000.

Will we someday be seeing ham rigs with a tiny digital camera built in? Only if the hobby doesn't get wiped out by the CW-forever mongers. Hey, would you like to see some video of me swimming with the turtles off the coast of Maui? Or how about the ham gathering on skis on top of Aspen Mountain? Or maybe our ham hunting safari in Africa? Or maybe my visit to the Taj Mahal with a group of Indian hams? Burma? Nepal? Navassa? News at eleven.

Okay, Who's the Quack?

The only ham doctor I can think of right now, the last I heard, is in prison for paying someone to kill his wife. But if there are any ham docs tuned in, I suggest you move on to my next topic and skip reading this. And that goes megadittos for anyone who is a True Believer in our beloved medical establishment. Yes, I've been reading some more books.

My work with a new model of the mind some 40 years ago got me interested in reading up on the various schools of psychiatry, psychoanalysis, and hypnotherapy. Using this model with some hypnotism I found I was able to quickly diagnose and

repair just about any kind of mental problems. And that was something no other approach to mind repair came even close to being able to do.

If you've read much of the literature you know that, in every careful test, none of the mental repair approaches are able to do any better than just giving people tranquilizers. The whole psychiatry business is smoke and mirrors, promoted to a gullible public as reality.

Okay, so I knew the psychologists and psychiatrists were humbugs, but I still had faith in medical doctors. This faith has been shaken recently as I've read more and more about alternatives to the establishment's use of drugs, radiation, and surgery to tackle the symptoms of illness. Doctors aren't even taught how to avoid illness in medical school.

Now I'm reading, *Immunization, The Reality Behind the Myth,* by Walene James, 285p, ISBN 0-89789-360-3. It's a very well researched book and it explains a lot about my own health. And probably, yours. You are so thoroughly inculcated by the media in the reality of vaccinations that you'd better read the book. I know you're not going to believe me when I encapsulate what it says. I really hate finding out that I've been a grade-A sucker all this time.

The bottom line is that not only don't vaccinations do any good, they're doing incalculable harm. The theory itself is baloney, and the billions of dollars doctors and pharmaceutical companies are making is nothing compared to the later costs resulting from the damage done. Yes, I know all about the diseases which mass vaccinations are supposed to have eliminated. So does the author. That's been a huge con job. Read the book

I was a healthy youngster until I had my first vaccination, which was required for me to enter school. Soon afterward I got sinus trouble, and for almost 10 years, and despite nose drops of Neo Silvol or Ephedrine several times a day, I was unable to breathe through my nose, even for minutes. When I was seven I suddenly developed massive allergies, to animals, foods, trees, pollens, dust, and so on. Hay fever, asthma, the works.

These are common results of the destruction to one's natural immunity system caused by vaccinations. Wait until you read the list of problems vaccinations cause! They kill a small percentage of kids outright. Doctors claim this is an acceptable loss, considering all the benefits resulting. Others suffer hyperactivity, autism, attention deficit, dyslexia, multiple sclerosis, cancer, leukemia, arthritis, diabetes, meningitis, tuberculosis, polio, smallpox, chicken pox, obesity, bulimia, thyroid damage, sexual disorders, etc.

Before the smallpox vaccine was discovered, there were almost no cases of smallpox in Japan. Then they instituted compulsory vaccinations. This resulted in 165,000 cases of smallpox, and 30,000 deaths. During the same period in Australia, where they did not have compulsory vaccinations, there were only three deaths. I'm not sure that's really enough to get anyone to think.

And how about cancer specialists in Canada, the US, and Britain who point to a definite link between the polio vaccine and cancer? By the way, the polio vaccine has killed far more children than the disease ever has unassisted by the vaccine. Oh, just read the book and see if it gets you to think.

I'd ascribed the change in family values to Dr. Spock's teaching the baby boomers not to discipline their children. But it could be that childhood vaccinations, plus later booster shots, are the real culprit. They have a tendency to make people more short-tempered and resistant to change. This could help explain our soaring divorce rate and ignored children. "Go watch TV and shut up."

As I've mentioned in my editorials, and in my book of WWII submarine adventures, the doctors came very close to killing me with a tetanus vaccine. It was only my own caution and firm resolve that saved my life. They were really pressuring me to have the shot, and it undoubtedly would have killed me. Thousands of people have died from vaccinations and hundreds of thousand gotten seriously sick.

If you knew that permanent illness or death was a distinct possibility for you or your children, would you voluntarily get those shots? Maybe you remember that last year's Miss America was deaf as a result of a childhood vaccination? Probably not. And I think her sister lost part of her hearing too.

Dr. William Douglass has a new book out claiming that the so-called Gulf War Syndrome is just the reaction to the barrage of shots all our combat troops were given before heading to the Middle East. The soldiers from the European countries did not get these shots and have not reported any of the resulting illnesses. The military does not make any tests before giving the shots, so it's no wonder they have deaths and a wide array of other bad reactions. And once your blood is poisoned by bypassing its defenses against these viruses and germs, you can't ever unpoison it.

There are endless reports of brain damage resulting from vaccinations, but not one report of brain enhancement. Yes, of course they are mandatory and the government will put you in prison if you refuse to have this poison injected into your body, or try to keep your children from being permanently poisoned.

But please don't believe me. Read the book and the overwhelming substantiation of every aspect of this, complete with the truth about all the lies used to force vaccinations on us. They don't work. They have not played any significant part in the reduction of any diseases anywhere in the world. They are a giant multi-billion dollar scam that is doing us all terrible damage.

Hey, maybe you can get your doctor to read the book. He's just as brainwashed about vaccinations as you are, in all probability. But then most dentists are by now aware of the serious damage putting amalgam fillings in your mouth can do to you, but they're still using 'em, and their patients are being slowly poisoned as a result.

Are Darwinians Wrong?

I watched a debate between a Darwinian Evolutionist and a Creationist on PBS the other night. The Creationist not only believed that the Bible's Genesis story is the truth, but that it should be taught in schools instead of the Darwinian theory of evolution: the survival of the fittest. The Scopes trial apparently didn't convince everyone.

The Creationists are upset because the Bible says man is built in the image of God, and the Evolutionists say, in essence, that he's descended from apes. Well, that isn't exactly what they say, but it's close enough. Actually, Evolutionists believe that man and apes are descended from a common ancestor. But one part of the evolution theory that really sticks in the Creationists' craw is the idea that evolution's mutation process is believed to be completely random and not divinely controlled.

It annoys me when scientists go about their business with blinders on. Blinders? Ask the next scientist you meet about ghosts. I have a great deal of trouble totally ignoring the sincere testimony of thousands, and even millions, of people who report things that are currently outside accepted scientific beliefs. Like what? How about ghosts, UFO reports, contactee stories, crop circles, precognition, reincarnation, past lives, near-death experiences, out-of-body experiences, psychokenisis, telepathy, psychometry, psychics, fortune-telling, the power of prayer, angels, poltergeists, voodoo, luck, synchronicity, serendipity, clairvoyance, and so on?

Sure, some of these may be 100% hooey, but where we have thousands of people all around the world reporting the same phenomenon, it's difficult for me to accept that every single one of them is either lying or crazy. Hey guys, maybe it's time to take off the blinders.

Tens of thousands of near-deathers have reported back on their visit to heaven and meeting with God. Isn't it odd that their reports are remarkably similar, no matter what religion they believed in before their experience? And, even odder, when they come back after being told that they have more to do in life, they are usually more religious, but no longer follow the religion they went in with. And they no longer have any fear of death.

They *do* believe in God, but they no longer consider themselves Catholic, Moslem., or any standard brand of Christian, and they're no longer sporting a "Honk if you love Jesus" bumper sticker. I'm not pushing any particular religion, or against any of 'em, I'm just telling you what you'll find if you read some books on the subject.

But that's a side issue which will undoubtedly have the overly-religious furious with me, just as are lawyers when I give facts about them, and ditto most doctors...at least the well-indoctrinated ones. And teachers. No, I don't condemn all of the above, knowing that there are exceptions to the rule. I've met Afro-Americans who don't hate Euro-Americans. I've met intelligent, progressive teachers. I've even met a few honest lawyers, and doctors who are actually open to at least consider alternatives to the usual drug and slash attack on symptoms, and never mind the causes of illness.

That long list of weirdness all comes under the heading of "life" for me. Life is quite separate from matter, though it has to use matter to deal with matter. I'll explain what I think matter is some other time.

Anyway, somewhere lost to history, the first DNA molecule was assembled. This was a molecule which could not only replicate itself endlessly, but also was able to modify itself as a result of the environment and keep that modification in memory. All known life depends on this molecule.

Dr. Fred Hoyle, in his book, *Evolution From Space,* estimated the odds against the DNA molecule being assembled by chance. He compared it to the chance that a tornado sweeping through a junkyard would assemble a complete 747. Well, it does seem odd to some scientists that nature hasn't come up with at least two basic life forms. Hoyle, by the way, is a world-renowned astronomer, so we're not dealing with a science-fiction writer off on a hare-brained crusade.

If you've done much homework in the occult field, you know that as people get in better touch with themselves they develop a feeling of oneness with all life. I've been there, done that, so I know how it feels. I'll tell you about that experience some time. I've put off writing about it because I don't want the Scientologists putting out a contract on me. I wish I was exaggerating.

Say, have you read *The Secret Life of Plants,* which I recommended? Or *Kinship of All Life?* Or *The Secret Life of Your Cells?* Do your homework so when we meet on 20m we'll have something interesting to

talk about...other than the model rig you're using.

Anyway, it seems reasonable to me that life, whatever it is, has a good deal of power to influence matter. We see it in luck, psychokinesis, and so on. So why shouldn't this life force also be able to modify evolution towards its own goals? If the original DNA didn't arrive from space a la Hoyle, perhaps it was the life force which assisted its original assembly?

Of course, if DNA did arrive from space, that just moves back the clock. DNA had to start somewhere, somewhen. And if earth is continually being peppered with DNA-based life forms from space, as Hoyle proposes, it does explain a lot of anomalies. Like why so many diseases suddenly spring up in a number of widely separated areas, all at the same time. And why so many new species have suddenly appeared in history without any apparent evolutionary bridges.

If "life" is influencing evolution, that might to some degree mollify the Creationists. It would certainly make life simpler for Evolutionists, who have a really tough time explaining the rapid evolution of specialized species of animals and plants adapting to new conditions. Shades of Lysenko!

So let's do our best to take off our blinders and be open to information which may not seem to be in line with our inculcated beliefs. The more you learn, the more I think you'll see how things start fitting together. All living things exhibit awareness, even CBers. Where we are different from animals and bugs is in our awareness of our awareness. Our drawback is a tendency to believe our senses. We believe what we see, so when some joker comes along and tries to convince us our senses are wrong, we kill him. Everyone can plainly see that the sun is going around the earth. And the stars, too. And the earth sure looks flat to me.

It comes as a shock to some when people find out that over 12,000 years ago astronomers worked out the circumference of the earth to within a 163 miles (they didn't allow quite enough for the bulge at the equator). And they even knew that the earth wobbled on its axis with a period of 26,000 years.

Copernicus and Galileo did not have an easy time convincing the scientists of their day that their beliefs and senses were wrong. So what's changed? The mental trip from believing that the earth was the center of all creation to understanding that it is a small planet in a relatively new solar system, out toward the edge of one of billions of solar systems in our galaxy...and that our galaxy is just one of billions of other galaxies, is a terrible downer. And where does God fit in this mind-bogglingly enormous universe? If you have an NDE and think to ask The Big Guy, please let me know when you get back.

Vanity Calls

The FCC is gradually phasing in vanity callsigns. They'll cost you $30 for a 10-year license. Cheap enough. When they get started, the FCC will be accepting applications (form 610-V) for the reissuance of calls you may have had in the past and lost, or the call of a deceased close relative. Hmm, I wonder if I should apply for W4NSD or W8NSD, or perhaps WR1AAB? Or K2PMM? I've had a bunch of calls down through the years, but I guess I'm stuck with W2NSD/1 until the Commission eases their restrictions so I can get "W."

Phase two will be open to Extra Class licensees. Then Advanced Class. And when that's all taken care of, any licensee will be able to invest $30 to get rid of KF4ZXZ, or some other awful combo.

The Candy Company used to issue the same suffix in a new area when you moved. That's how I got W4NSD, when I moved to North Carolina. And W8NSD, when I moved to Cleveland to work at WXEL-TV. By the time I moved to New Hampshire in 1962, the CC had stopped this generosity, so even though W1NSD was open and available, they wouldn't let me have it. They said they expected the rules to be changed soon, so just to operate portable and hold my water. I'm still holding 33 years later. I probably don't have the record for operating portable, but I'm right up there.

It's probably been months since I've told you about my operating in the Sweepstakes contest from Ohio in 1951 as W2NSD/8. Then, just as my W8NSD license came through, I moved back to New York, so I operated the second weekend of the contest as W8NSD/2. The only common piece of equipment was the microphone. Even so, I did well in the contest.

Someone else has been issued my 1958 license for Navassa, KC4AF, so I won't be able to get that one back. Drat!

The address for the vanity calls, once the FCC gets their computer programmed, is: FCC, Amateur Vanity, Box 358924, Pittsburgh PA 15251-5924.

Alchemy Today

If you know anything about chemistry at all you know that you can't turn lead into gold. Well, it seems that the old alchemists were a little further along than history has been leading us to believe. It wasn't lead, it was mercury that they were transmuting into gold, and the "philosopher's stone" they used to help the action was made of phosphorous. I know you're going to find this difficult to believe, but the Japanese have been doing a good bit of research on this more recently, and with considerable success.

My interest in the transmutation of elements began when I read the Bird-Tompkins 1976 book, *The Secret Life of Plants*. There was a chapter on how chickens are able to convert the potassium in mica into calcium for their eggshells. It almost got me to think. So I chased down Christopher Bird and got up to date on some of his newer books. His *Secrets of the Soil* is fantastic. It's a must read. I also got in touch with Cleve Backster, the chap who did much of the original work on communicating with plants. And he put me on to Brian O'Leary and *The Secret Life of Your Cells*, another fascinating book. But I've told you about those and you should have read 'em by now.

Chris suggested I look up the transmutation work by Michio Kushi. I found him and think you ought to know about his 1994 book, *The Philosopher's Stone*. Before you dismiss transmutation via biological processes as baloney you should at least look at the remarkable research data Kushi presents. He makes a very good case for the heavier elements on earth being made biologically from carbon, oxygen, and nitrogen instead of having to have originated from a supernova explosion, which is the current scientific dogma. It turns out that many scientists have researched this area with very positive results.

For instance, take $_{11}Na^{23} + {}_{8}O^{16} \rightarrow {}_{19}K^{39}$, for starters. Kushi put 2.3 mg of sodium in a vacuum, then ran an electric current through it until it was melted. Then he added 1.6 mg of oxygen. The result was 3.9 mg of potassium.

Then there is the data from Louis Kervran, who carefully checked the input and output of food and wastes from a group of men working in the Sahara in 1958. They generated far more magnesium output than input. Ditto potassium. More than could be accounted for in any way other than biological transmutation.

I think you'll enjoy the book, and it may almost get you to think. Or not. It's $10 (plus s/h) from One Peaceful World Press, Box 7 Becket MA 01223, ISBN 1-882984-07-2; 413-623-5741.

One of the reasons I got interested in transmutation is that the scientific establishment has been putting cold fusion down because it seems to involve the changing of hydrogen into helium, and "everybody knows" that alchemy died a deserved death a couple centuries ago.

Those Pesky ETs

Somehow, in amongst trying to keep up with the editing and production deadlines for two magazines a month (*73* and *Cold Fusion*), I also manage to read my mail and even answer some of it. For instance, I got a wonderfully chatty letter from Frank Thomas W4QDM. It didn't hurt when he started off saying how much he likes my editorials and the challenges I provide. He's been reading many of the books I've recommended and enjoying them.

Sure, I could just write about amateur radio, but my editorials are more like a monthly contact with you, where I talk not just about the hobby, but about anything else I think you might find interesting. And that's what you like about some of the ham contacts you make, isn't it? So get off the concept of everything printed being a lecture and get the idea of communication.

Anyway, Frank mentions that he's interviewed two people from Sylvania (GA) who had good close looks at a UFO which had landed in a field near town. One was a retired meteorologist from the Dept. of Commerce, and the other was the owner of radio station WSYL, so their credibility was high.

Unless you've been living in a cave with no radio or TV, you've seen and heard plenty of UFO stories. I've got stacks of UFO books—some are kooky, but many are well researched. The author of one was a good friend of mine, Jay Stanton. I've forgotten his ham call. When I first moved to New Hampshire he used to come up and visit. He went into the UFO book project as a skeptic, with the intent of exposing the whole business as baloney. He soon was convinced that most of the reports were real. Millions of people have seen UFOs and they're not all crazy. Thousands have reported being abducted, many repeatedly.

Another reader sent me a most interesting tape of David Jacobs talking about the real purpose behind the abductions. More *National Enquirer* stuff, right? Only if you don't do your homework. It's easy to dismiss something you don't know much about. Look at the fools some top scientists recently made of themselves in dismissing cold fusion. And we had the spectacle of the medical establishment trying for years to deny *H. pylori* as the cause of ulcers. And the ongoing power company fight against EMF dangers, the tobacco companies and cancer, and the ADA's fight to continue the use of dental amalgams despite all the scientific evidence of their destructiveness.

With the Big Bang theory now having been pretty well discredited, scientists admit they haven't any clue as to the age of the universe. This tends to make the possibility of there being alien visitors from more advanced civilizations much more likely. And then there's the possibility of time travel to further confuse things. We've enough reports of verified precognition to know that we still have a lot to learn about how time works.

I'll keep letting you know about the books I've found which I think you'll enjoy. When you come across a book you think I should read, please let me know. 73

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Continued from page 71

you will see that the blip at 3 kHz is one-third the height of the fundamental at 1 kHz, and so on.

The presence of harmonics has an important effect on communications. Whenever we talk about sending a signal from one place to another, we have to make sure that all the components of that signal (or, at the very least, the *important* ones) get through as well. This brings us to the concept of bandwidth.

Bandwidth

Consider piano music. Obviously having a phonograph that covers the range from 27 Hz to about 4,200 Hz will let through all the notes, allowing us to recognize the melody.

But a restricted range like that does not sound like a very good piano. To make it sound realistic, you must let through all the harmonics—or at least the ones you can hear. That is why modern hi-fi equipment typically reproduces up to 20,000 Hz (or, at least, that's what

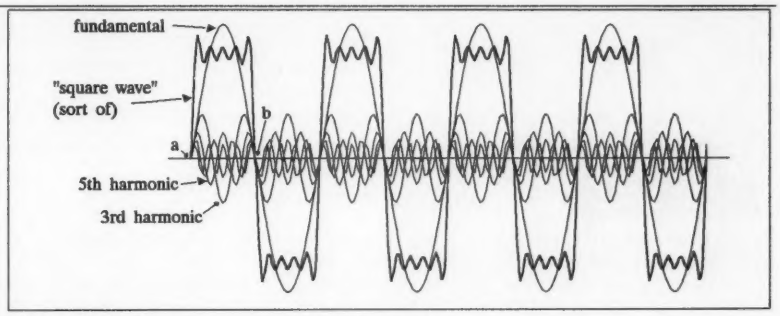

***Fig. 10.** Making a square wave out of a sine wave.*

DETOUR

Detour 2

Let's talk about filters for a moment. Suppose you get several pieces of colored glass—one red, one green, one blue. When you look at a light bulb through the red glass, you see red light. Look through the green glass, and you see green light; look through the blue glass and you see blue light.

Don't think of the colored glass as a filter that is changing the white light into colored light. Instead, remember that white light consists of many colors, all combined together. The colored glass is simply a filter letting one color through, while stopping all the other colors. We can demonstrate that easily be putting the green and red glasses together and trying to look through both of them. When the white light goes through the red glass, only red light comes out. There is no green light left, and so when that red light hits the green filter, it is all stopped and nothing comes out (assuming that the filters are good enough).

If we have light from some unknown source, colored glass filters let us test that light to see what colors are in it. If we use a particular color glass, and nothing comes through it, then we know that that particular color was not generated by the unknown light source. But we can also interpret this result in a different way: if what comes out of the glass filter is different from what went in, then the original light must have had some colors in it that did not pass through the glass.

In the same way, electronic filters, like those in Figure 9, let us test an electrical signal to see what its components are. When we put a 1,000-Hz square wave into a 1,000-Hz filter, but a sine wave comes out, this tells us that the original square wave must have some other frequencies in it that cannot get through the filter.

the manufacturers claim!) In fact, 15,000 or even 10,000 Hz would probably do for us older people whose hearing no longer extends to 20,000 Hz (pity!)

Let's look at the frequency ranges covered by various pieces of equipment:

- SSB transceiver—about 300–2,700 Hz.
- Telephone line—about 300–3,500 Hz.
- AM broadcast station—about 100–10,000 Hz.
- FM broadcast station—about 50–15,000 Hz.
- Compact disk—about 5–20,000 Hz.

Looking at these frequency ranges, we can clearly see which equipment will handle music best, and which is merely good enough for voice. (See Detour 3.)

So far, we've taken a short look at the nature of audio. We have seen that audio signals consist of frequencies in the range of about 20 Hz to about 20,000 Hz, but that a narrower bandwidth suffices if we're not too concerned with quality. For example, a typical telephone circuit can handle only the range of about 300 Hz to about 3,500 Hz.

A frequency range up to 3,000 Hz or 4,000 Hz is good enough to understand speech and even to recognize the voice of the speaker, but it is certainly not hi-fi. Let us now look where time comes into this.

Time

Say you have 20 minutes of things to tell him. You decide to record it on tape at a low speed. Then you rewind the tape and play it back, but at double the speed so that it takes only 10 minutes to play. Can you thus send 20 minutes of speech, but pay for only a 10-minute phone call?

You can certainly do that, but your voice will sound like the Chipmunks (that's how they do their voices!) and may not be too understandable. But suppose your friend records your voice on another tape recorder, but this time records at high speed and plays it back later at half-speed (try this with a Chipmunks record!) This stretches the 10 minute tape back into 20 minutes. Will this work? (And if it does, can you speed up the tape by a factor of 10 and pay for only a 2-minute call?)

Yes . . . and no. What happens is that as you double the speed of your tape, every frequency on the tape gets doubled too. A 1,000-Hz component of your voice becomes 2,000 Hz, and so on. The problem is that every component of your voice that is above 1,750 Hz or so gets doubled to above 3,500 Hz, and therefore doesn't make it through the phone line. In other words, your friend will only hear those components in your voice that are below 1,750 Hz. (And if you tried to speed things up by a factor of 10, he would only hear those parts of your voice that are below 350 Hz.)

In other words, it's the bandwidth of the telephone line that limits how much information you can get across in 10 minutes. If you used a higher-bandwidth line—such as the special lines that broadcast stations lease from the phone company for studio-to-transmitter links, which cover up to 10,000 or 15,000 Hz—you could easily speed up your tape by a factor of 3 or 5, and still transmit all of your message (though still only at normal telephone-line quality).

So the idea is that there is a tradeoff between bandwidth and time. If you have a fixed amount of information to send, you can send it fast if you have a lot of bandwidth. But you have to send it more slowly if the bandwidth is small. That explains why, for example, a fax transmission can go through a regular telephone line, but a full-motion TV video image can't. The fax takes up to a minute to send one picture, whereas the TV has to send it in 1/30 of a second.

Summary

Although the discussion has rambled off and on about various aspects of audio, we've actually covered a lot of ground. We have seen the characteristics that make up an audio wave—the frequency, wave shape, and amplitude of the signal. We have looked at how harmonics affect the wave shape, and how the bandwidth of a system affects the sound quality that you can send through it. Next time we will tackle transmission of video. 73

DETOUR

Detour 3

While we're on the subject of hi-fi equipment, let's discuss a few more terms.

It's not enough for a piece of hi-fi equipment to cover a wide range of frequencies; different frequencies in the range have to be treated equally. That is, an amplifier or tape deck that covers 20–20,000 Hz, but provides a lot less gain above, say, 1,000 Hz than below, would sound very bassy. Ideally, hi-fi equipment should be able to handle signals of different frequencies equally well. Evenness of response is usually rated in *decibels* or dB. For example, a typical amplifier might have a rating of "20–20,000 Hz ±1 dB," which means that the gain (how much it amplifies) does not vary more than plus or minus 1 decibel from some midscale value. (We'll have a detour later to explain decibels.)

In addition to having a wide frequency range, the hi-fi device also should not distort the signal. That is, its output waveform should look like the input waveform (except for possibly being larger or smaller). One way to rate distortion is as THD or *total harmonic distortion*. Remember that it's the harmonics that make one signal of a given frequency different from another signal of the same frequency. Hence if the output from an amplifier or recorder looks different from the input, its harmonics must somehow have been changed. The standard way of measuring this is to insert a pure sine wave test signal (that has no harmonics), and look to see whether there are any harmonics in the output. If so, then the signal got distorted. The THD number is a percentage that tells how much harmonic voltage got added to the pure signal. For instance, if the output from an amplifier (with a sine wave input that should have no harmonics) is 10 volts of fundamental and 2 volts of harmonics, then there would be 20% THD (a terribly high number, by the way. THD values of under one or two percent are more desirable).

Actually, though, harmonic distortion is not nearly as bad as you think. Since music and speech normally have harmonics anyway, adding an extra percent or so of harmonics to them is not too noticeable. Amplifiers and other all-electronic hi-fi equipment tend to have low distortion, but tape recorders and mechanical components such as phonograph cartridges and speakers often have a high THD (sometimes as much as 5% to 10% for speakers).

Much more dangerous is IM or *intermodulation distortion*, which introduces new frequencies not in the original at all. Even 1/2% or 1/4% IM distortion is grating and unpleasant. Unfortunately, IM distortion is not very often listed in spec sheets for equipment; fortunately, however, IM distortion sort of goes hand in hand with THD, and a hi-fi device with low THD *probably* also has low IM.

Finally, hi-fi equipment should have very little noise. Noise can appear in the form of a low-pitched hum (often caused by a bad power supply, bad grounding, or bad shielding of a wire) and a high-frequency hiss. Either one is bad. Hi-fi equipment specs therefore often list the SNR or *signal-to-noise ratio*. This is the ratio between the loudest music it can handle and the noise. For example, in a CD recording, the loudest music voltage is typically about 65,000 times higher than the noise voltage, while in a cassette recording it might only be 300 or 400 times stronger. In a telephone circuit, the ratio between the loudest voice signal and the noise might be as low as 10 to 1. Since we're holding off on our discussion of decibels, let me just say at this point that the 65,000 ratio is equivalent to about 95 dB, the ratio of 300 to 400 is about 50 dB, and a ratio of 10 is only about 20 dB.

Number 79 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the May issue, we should receive it by February 29. Provide a clear, concise summary of the essential details about your Special Event.

JAN 13

HARRISBURG, PA The Harrisburg RAC will hold a Hamfest 8 AM-Noon at Oberlin FC Social Hall. For info, call (717) 232-6087; for table reservations, write *Tom Hall WU3X, Box 418 Halifax PA17032.* Talk-in on 146.76 and 146.52.

LOVELAND, CO The Northern Colorado ARC will sponsor the Winter Superfest at the Larimer County Fairgrounds, 700 S. Railroad. Talk-in on 144.515/.115 Pl 100 Hz; or 146.25/.85. VE Exams, tables, contact *Jeanene Gage N0YHY, (970) 351-7327. For general info, call Michael Robinson AA0UB, (970) 282-1167.*

PHOENIX, AZ The ARC of Arizona, hosted by ThunderBird ARC, will hold the West Valley Hamfest (WestFesT) at Glendale Comm. College, North lot, 6000 W. Olive (Dunlap & 59th Ave.). Contact *Morgan N7DLW, (602) 938-4356,* or *Mark N7KQ, (602) 843-0960.*

JAN 13-14

SARASOTA, FL The Sarasota Hamfest and Computer Show will be held 9 AM-5 PM Sat.; 9 AM-3PM Sun. at the Robarts Sports Arena, Sarasota Fairgrounds, 3000 Ringling Blvd. Contact *Sam Everts KE4BXF, (941) 927-8999.* Talk-in will begin at 8 AM each day on 146.31/.91 and 444.925/449.925 Rptrs.

JAN 14

DOVER, OH The Tusco ARC Hamfest will be held at Ohio Nat'l. Guard Armory, 2800 No. Wooster Ave., starting at 8 AM. Setup at 6 AM. Contact *Howard Blind KD8KF, 6288 Echo Lake Rd. N.E., New Philadelphia OH 44663. Tel. (216) 364-5258.* Talk-in on 146.730(-).

JAN 20

GOWER, MO The 6th Annual Northwest Missouri Winter Hamfest will be held 9 AM-4 PM at the Ramada Inn in St. Joseph MO. Sponsors: Missouri Valley ARC, Green-Hills ARC, and Ray-Clay ARC. Commercial exhibitors welcome. Contact *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WB0W, 121- Midyett Rd., St. Joseph MO 64506.*

JAN 21

YONKERS, NY The Metro 70cm. Network will present a Giant Electronic Flea Market 9 AM-3 PM at Lincoln H.S. VE Exams. Indoor Flea Market. For registration, call *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 449.425 MHz Pl 156.7; 223.760 MHz Pl 67.0; 146.910 Hz; and 443.350 MHz Pl 156.7.

FEB 3

KNOXVILLE, TN The Shriners of Kerbela AR Service will sponsor the Kerbela Hamfest at the Kerbela Shrine Temple, 8 AM-4 PM. Setup Fri. 4 PM-9 PM; Sat. 5 AM-8 AM. FCC Exams by WCARS-VEC. Reg. until 9:30 AM. Mail completed 610 form with check for $6.05 payable to *WCARS-VEC, Ray Adams N4BAQ, 5833 Clinton Hwy., Suite 203, Knoxville TN 37912-2500. Tel, (423) 688-7771.*

ST. CATHERINES, ONT., CANADA The Niagara Peninsula ARC Big Event #18 will be held at the Canadian Auto Workers Hall, 124 Bunting Rd., 9 AM-2 PM. Setup at 7 AM. Contact *Marg Sewell VE3HOX, NPARC, P.O. Box 20036, Grantham Postal Outlet, St. Catharines ON L2M 7W7. Tel. (905) 680-1211.*

FEB 3-4

MIAMI, FL The 36th Annual Tropical Hamboree Amateur Radio and Computer Show will be held at Dade County Youth Fair and Expo Center, S.W. 112 Ave. & Coray Way. Sponsored by Dade Radio Club of Miami. Talk-in on 146.925. Booth and table info: call *(305) 642-4139;* or *Fax (305) 642-1648.*

SPECIAL EVENT STATIONS

JAN 20

SANDUSKY, OH The Sandusky Radio Experimental League will operate W8LBZ 1500Z-2400Z to celebrate the 100th Anniversary of the "Boy with the Boot" statue, Sandusky's official symbol. Operation will be in the General 40, 20, 15m bands, 146.655(-), and 444.375(+) Rptrs. For a certificate, send an SASE to *W8LBZ/SREL, 2909 W. Perkins Ave., Sandusky OH 44870.* 73

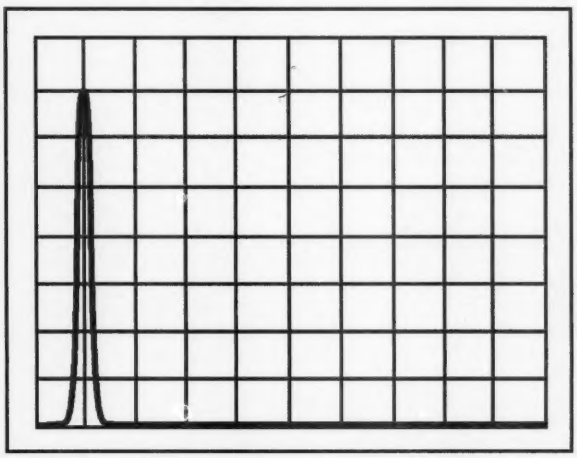

Fig. 11. Spectrum of a 1,000-Hz sine wave.

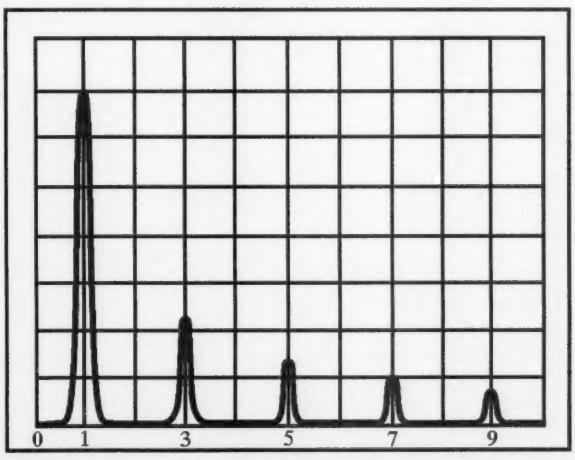

Fig. 12. Spectrum of a 1,000-Hz square wave.

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Wayne's Book!

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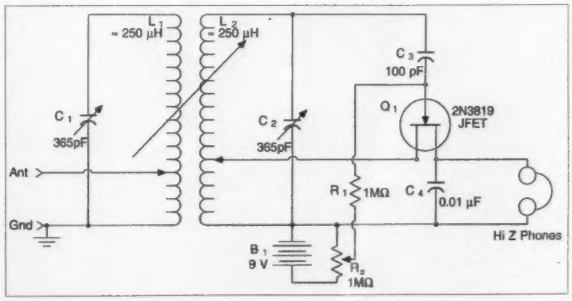
UPDATES

In December's *73,* we ran David W. Cripes KC3ZQ's article, "Nostalgia for the Future," without the all-important schematic. Here it is: 73



The Ultimate Crystal Receiver

The index and/or table of contents has been removed and photographed separately within this volume year.

For roll film users, this information for the current volume year is at the beginning of the microfilm. For a prior year volume, this information is at the end of the microfilm.

For microfiche users, the index and/or contents is contained on a separate fiche.

LETTERS
Continued from page 6

my license. In 1987, I re-tested and quickly acquired my General License again. Late in 1994, I passed the Advanced Class upgrade, and in August 1995 I upgraded to Extra Class. I have had to renew my high school memory of trigonometry, as well as learn how to use a scientific calculator. My main talent is sewing, not electronics, but I passed the test, three months short of being eligible for Medicare. And I understand that keeping the mind active wards off Alzheimer's disease and other maladies. I am very appreciative of the ham community, which has kept the bands active throughout the years in order that those of us who have been less active still have frequencies on which to operate. That means the old-timers. They probably have more stick-to-it-iveness than some of the newcomers. If they have not become bitter through the years, they have more manners than some of the younger generation. And manners speak well for amateur radio. And, off of that subject: May I suggest/request that it would be easier to respond to "Feedback" if the back side of the listing were an ad, rather than an article or printed circuit diagram?

Noted . . . Wayne

Jack Conway N5YIS I never go to hamfests, so I thought that I would never have an opportunity to hear you speak. When I read in *73* that you had a tape for sale, I just had to have one. Here is my five bucks: After reading years of good money-making ideas from you I thought I would send you two that you can have free of charge. Your offer to sell back issues of *73* was tempting, but like most people I don't have room for any more magazines. I do, however, have room for more CD-ROMs, so why don't you scan all your back issues onto CD ROM's and sell them? I know I would buy them just to read all the editorials. Why don't you put your audio publishing house to work putting together a Morse code CD? Reading the different magazine I read, I have always wondered why nobody put together a Morse code trainer on CD. Most CD players have a random play feature. I think it would be the best medium for practicing code. Keep cranking out the quality editorials.

Sure, I'll bet I could sell dozens of CD-ROMs of the back issues. Let me know if you'd like to scan in the 50,000 pages for me. Or maybe I could get some retired ham to scan in my over 1,000 editorials. I'll bet I could sell scores of those on a CD-ROM. We did a CD-ROM listing of every known CD back in 1989 and sold dozens of 'em. We even scanned in the color covers for hundreds of 'em, and had sample tracks of the music. It sold like cold cakes. The code? All it takes is one one-hour tape at 13 per to learn the code from scratch. And one at 20 wpm for that speed. Why would anyone put an hour of code on a CD when a tape does it just fine? . . . Wayne

Dave Kaun N9KMY It is truly time for our hobby to move into the new technology age. We need to substitute application of technical skills for Q&A manual memorization and the copying of the code as a method of advancement. Memorization, popular as a teaching method in previous generations, is no longer the way learning takes place today. While we expect our youngsters to understand and apply huge amounts of technical information, why are we still requiring memorization in amateur radio? Let's make our hobby a natural learning progression for technically literate students interested in what ham radio offers.

After many years of being involved with electronics as a hobby and as my career, I became a Technician before the no-code license was offered. To me the technical side of the hobby is much more important, though I would enjoy working HF if it were not for the artificial barrier the code presents. I find it quite interesting that many who once long ago learned the code can't carry their side of a technical conversation equal to the license they hold, nor even remember the code well enough to use it. More than memorization is needed today to understand technology; just ask any engineering student if formula or fact memorization is enough. Learning and understanding applications is much more important. We need to follow that same methodology of learning in amateur radio. Keep up the good work and the excellent magazine.

Philip Weaver VS6CT Wayne, it's been awhile since our paths crossed. I am leaving for the CRSA DX Convention in Beijing later today and was remembering how we met in the BY1PK Radio shack in Beijing back in 1984, when I was assisting with the communications associated with the Hong Kong-to-Beijing "555" Car Rally. I retired from the Hong Kong Government in February of this year and I have not stopped since. I will be dashing around Asia for the next two months, with visits to Bali, Thailand, Hainan Island on the South Coast of China, and Kota Kinabalu. I sold my flat here in Hong Kong and will be leaving for England in December to join the QE2 out of Southampton for a four-month round-the-world cruise. I am hoping that I will have managed to organize the setting up of a ham station on board and am awaiting word from Chip Margelli of Yaesu to supply me with a radio as the official sponsor of the station. I'll return to England in mid-April and expect to be back out here in Hong Kong in late May to try to find a flat where I can put some decent antennas on the roof. I am very bullish and optimistic about the future of Hong Kong, which is why I want to stay here, apart from the advantages of being somewhere that I know. I've enjoyed living here for 22 years. I just hope that my faith will be justified in the future. I still read your editorials with enjoyment, I just wish that they could produce more results. Keep at it Wayne.

Phil, I hope your trust of Beijing not ruining Hong Kong is justified. It's too bad the changeover isn't in 10 more years, after China has had an opportunity to adjust to capitalism . . . Wayne 73

Free Electricity
Continued from page 34

conditioning and refrigeration. A superefficient Sun Frost refrigerator will replace the old conventional unit when it dies. The Sun Frost unit retails for about $2,700. A 16-cubic-foot Sun Frost uses 32 amp/hrs. a day at 24 volts. That's about one tenth the amount of power the old refrigerator uses.

Chuck also has a landline BBS operating 24 hours a day with an Amiga computer as the heart of the system. He can save a lot of energy by converting to a laptop computer.

As I mentioned earlier, when the wires were being pulled through the underground conduit, several multi-conductor cables were also installed. These data lines will eventually be used to monitor system parameters such as array temperature, wind speed and direction.

Are there any 12-volt DC loads? Yes, and a Vanner battery equalizer allows a 12-volt battery bank to be charged from the main 24-volt battery bank.

Author's Note

I'll be happy to do a computer sizing for your repeater or hamshack. There's no charge for this, provided you send along several first class stamps for return postage. I'll need your name and the nearest large city with an airport having a weather station operated by the US government. I'll also need the system voltage of your load (12, 24, 48 volts), and an estimate of the amp/hr load you expect. 73

BARTER 'N' BUY
Continued from page 72

CHIPSWITCH - To give your **HR-2510** and **HR-2600** the same features as the **BIG RIGS**, call (707) 539-0512, or write to **CHIPSWITCH** at 4773 Sonoma HWY #132, Santa Rosa CA 95409 for **FREE** information. BNB1033

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WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new-old-in-any-condition to the Radio Club of Junior High School 22, the Nation's only full-time, nonprofit organization working to get Ham Radio into schools around the country as a teaching tool using our EDUCOM—Education Thru Communication—program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 15th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANTLY, your gift will mean a whole new world of educational opportunity for children nationwide. Radio's you can write off, kids you can't. Make 1996 the year to help a child and yourself. Write, phone or Fax the WB2JKJ "22 Crew" today: The RC of JHS 22, POB 1052, New York, NY 10002. **24 hours call** (516) 674-4072 or **Fax** (516) 674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1200-1330 UTC daily, and 21.395 MHz from 1400 to 2000 UTC. Meet us at the upcoming Charlotte Hamfest. BNB762

Two meter SSB/Satellite Loops

A whole new world of fun lurks on the low end of 2M if you use the right antenna.

Gordon West WB6NOA
2414 College Drive
Costa Mesa CA 92626

The bottom end of the 2 meter band below 144.300 MHz is reserved exclusively for weak signal SSB and CW communications. No FM. Same thing between 145.800 MHz to 146.000 MHz—*no FM!* This area is reserved for weak signal satellite communications using SSB and CW. The term "weak signal" describes running 2 meter CW or single-sideband signals over great distances, well beyond normal FM 100-mile communication ranges. Weak signal modes like Morse Code (CW) and SSB (upper sideband) *cannot* coexist with FM transmissions because a nearby FM signal will literally cover up an ongoing SSB or CW QSO. So keep in mind that no FM is allowed below 144.300, and no FM between 145.800 to 146.000 MHz. Thanks for your cooperation!

Down below 144.300 MHz is where SSB communications span distances well beyond 100 miles. It's not uncommon for atmospheric tropospheric ducting to carry 2 meter SSB signals over thousands of miles, such as the path that occurred last summer between Nova Scotia and Florida. Last summer also saw the 2 meter SSB records shattered for the ultimate distance contact between Washington and Hawaii. The conditions lasted for several days!

Almost all communications on 2 meter SSB below 144.300 MHz use horizontal polarization, rather than vertical polarization. If you spot a beam antenna on a house that is mounted horizontal for 2 meters, chances are they're operating a 2 meter multi-mode SSB system. If you see a horizontally polarized antenna or a combination vertical and horizontal Yagi antenna pointed up toward the sky, this is probably a satellite set-up for 2 meter work. But there is probably one horizontal antenna that will really make you take a second look, and it is the 2 meter horizontal *loop* antenna.

"How about that 2m SSBNova Scotia to Florida contact last summer?"

This is what mobile units must use in order to obtain coverage, yet with a horizontal 2 meter pattern. The new popular ICOM 706 with 2 meter and 6 meter VHF capabilities in addition to high frequency capabilities will lead mobile operators over to a 2 meter horizontal antenna for work below 144.300 MHz.

A popular compact 2 meter square loop, called the "SQUOOP" is offered by M^2 Enterprises, Fresno, California (209-432-8873). The little 2 meter "SQUOOP" is housed within a black plastic cover, and offers unity gain omnidirectional coverage in an aerodynamic design that works well on any vehicle or mobile home as long as you get it well above the roof line. I have tested it against other loops, and its performance is O.K.

If size is not the object, consider the big cloverleaf horizontal loop that is a little bit more at home on your roof than on the roof of your vehicle. It's big, but all that metal really captures weak incoming horizontally polarized 2 meter waves. It's available from Laddy Reisinger N8EWU in Oceanside, California (619-722-8563. I found its performance slightly above the M^2 little loop, since all that metal captures a little more of the incoming horizontal signal.

Another Southern California ham, Norm Pedersen KB6KQ, Bellflower, California (310-925-0733)), has developed a "Mini Loop" that has a high performance for its small size and is easily stacked for a slight increase in weak signal capture capabilities. We recently tuned in Paul Lieb KH6HME, driving up the side of a volcano in Hawaii using a single Mini Loop, and his signal was making the 2,500-mile path extremely well. For the smallest loop with the greatest signal capture capabilities, this loop has it hands down. It's also a homebrew antenna offered to amateur operators on 2 meter SSB.

Another attention grabber is from the M^2 gang, a Mike Staal K6MYC special, Fresno, California (209-432-8873) is called the "Egg Beater." This can be used for both 2 meter horizontal SSB communications with terrific signal-grabbing capabilities, as wel! as right hand circular polarized mobile satellite work up at 145.800, too. The Egg Beater had best response to the Hawaiian 2 meter beacon when it was coming in just above the noise level. The Egg Beater did best, with the Mini Loop coming in a very close second, followed closely by the cloverleaf, followed relatively closely by the M^2 "SQUOOP." All of these antennas look out of place on a modern vehicle, but hey, that's the price to pay when you want to work 2 meter mobile SSB and regularly talk to other mobiles over distances beyond 100 miles. And we are not talking through repeaters, we are talking direct. The advantage of SSB simplex over FM simplex is double, triple, and sometimes quadruple greater on SSB than what you could do with wide and noisy FM.

I've also found many newcomers getting started with 2 meter SSB wanting something nice and compact. The gang at Cubex Quad Company rose to the challenge of a compact pre-assembled quad specifically tuned for the 2 meter band and operated either vertical for FM

or horizontal for 2 meter SSB. Cubex Company in Brea, California (714-577-9009) calls their little 4-element, pre-assembled, lightweight cubical quad the "Yellow Jacket," and everything comes pre-assembled where all you need to do is to poke the supplied fiberglass spreaders in through the holes on the boom, attach the pre-assembled and color-coded wire elements around the spreaders, run your coax, and sand off the ends of the spreader wire tips so they are nice and smooth in case someone should walk into your assembled quad antenna set-up. You know, safety first! The quad sells retail for under $40, and gives you a big boost in directional signal strength well above a simple ground plane home antenna or equal gain to a little 3-element Yagi. The quad also comes with its own mast and could serve as a wonderful direction-finding antenna, too. Everything is pre-assembled, so you don't have to do any measuring or anything—just follow the instructions, snap everything together, and presto, you are on the air with either vertical or horizontal polarization. For 2 meter SSB and CW, make sure you go horizontal and point the quad for best signal strength.

During extensive testing of omnidirectional mobile loops, all did a terrific job in pulling in extremely weak SSB signals, including the Hawaiian beacon thousands of miles away. But switching over to the quad and aiming it in the right direction definitely increased transmit and receive signal strength. Same thing in working the satellite.

You can also build these horizontal antennas yourself, like the gang in California has done for resale. But I recommend getting one already put together, tuned, and tested rather than trying to outdo what somebody has already spent years in design and testing. Learn from their hard work what it takes to make a good horizontal antenna even better through refinements. See whether or not bigger is always better, and check out some of the tuning techniques these experts have used to give you proper impedance matching and performance right where you need it on the weak signal portion of the bottom of the 2 meter band.

Number 85 on your Feedback card

RF Sniffer

Here's an ultra-simple piece of test equipment

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751

An old trick for sniffing out RF leaking around the shack can be useful in modern ham station installations. Any RF which does not reach the antenna is not only wasted power, it often can be the source of interference to radios, TV sets, telephones and other home electronics. The opposite is also true - if RF can get out, it can also get in - and RF from motors as well as household electrical and electronic equipment such as TV receivers, VCRs, etc. can raise the noise level in the ham receiver and otherwise interfere with station operation.

Old, surplus coaxial cable and some new coax is so poorly shielded it is little better than open wires. Coax which leaks RF should be replaced with high quality cable. Poor, leaky coax not only wastes RF which never reaches the antenna, it also can pick up interference over its entire length.

Gaps in shielding, especially in high power installations, and poorly soldered or loose RF connectors should also be corrected to eliminate leakage and possible interference.

The junk box solution to visual detection of stray RF is illustrated in **Fig. 1**.

Construction

Making the RF Sniffer is simple. A small diameter wood dowel, or a stiff wire cut from a coat hanger, about two fed long, has the NE-2 neon bulb and 120k Ohm resistor attached at one end with tape. The glass portion of the neon bulb must not be covered because it indicates the presence of RF.

A pair of wires connected to the neon bulb and resistor should be taped along the dowel or stiff wire, leading to the end where the 500k Ohm or one megohm potentiometer is taped or otherwise fastened. A piece of wood or plastic, or a long loop formed in the end of the coat hanger wire, can serve as a handle. The AC line cord is connected to the pot and the wire from the resistor at the handle end of the sniffer and all connections taped to prevent accidental contact.

Adjustment and Operation

Plug the sniffer into a source of 117 Vac. Observe the neon bulb while adjusting the pot. As resistance is decreased slowly, an orange glow will appear around one of the two electrodes in the neon bulb. A further decrease in resistance will result in the orange glow surrounding both electrodes.

Slowly back off the pot until the orange glow is again around only one electrode. Do not readjust the pot from this point!

Using the sniffer as a probe, with the transmitter producing power, investigate coax connectors and jumpers, coax runs, ac wiring in the shack or elsewhere in the house where RF is suspected, while observing the neon bulb.

When leaking RF is detected, the orange glow in the neon bulb will flicker and surround both electrodes.

If RF seems to be detected put the probe back and watch the neon bulb. If the glow retreats to surround only one electrode, RF leakage is present where detected. If, however, the orange glow continues to surround both electrodes, readjust the pot so it is visible around only one electrode and recheck for RF leakage. Because transients and other minor disturbances on the ac line are common, they can cause erroneous indications of detected RF when the sniffer is set at its most sensitive point.

Conclusion

This gadget is not frequency sensitive. It will work a well at UHF as it does at HF and even the TV horizontal oscillator frequency. It is extremely sensitive to low levels of RF. Best of all it is cheap, and can be put together from the usual junk box contents.

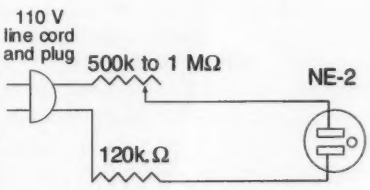

Fig. 1. How simple can you get?

Line Voltage Monitor

A one-hour construction project with a parts cost of under $5!

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751-0030

There are a number of 0-150-VAC meters available, but they're difficult to read when you're looking for small line voltage changes. A much more easily read meter is a suppressed-zero, expanded-scale meter which displays only voltages between 90 and 130 VAC. It can be read at a distance and at a glance so you can take action should your household voltage swing too high or too low. The simple circuit described here uses only five common components and can be constructed in less than an hour. The total cost, not including a box, should be less than five dollars.

Background

Power companies attempt to control both the level of AC voltage and frequency delivered to their customers. Though limits on both are established by regulations, some companies are better than others. However, as well all know, they have occasional problems which can possibly harm your equipment.

"Brownouts," common in urban areas in the US when air conditioners or electric heating systems require more power than anticipated, result in lower voltages being delivered to homes. Occasional overvoltages occur when power is switched from one substation to another, or to another point on the national power grid. Although nominal AC voltage in the US is 117 VAC, this can vary between 105 and 130 VAC, while remaining within specifications. Most household equipment is designed to tolerate excursions within this area. However, AC voltages lower and higher than these accepted limits can cause problems with your ham equipment.

AC line voltage can often fall as low as 90 VAC and stress AC operated motors such as cooling fans in amateur transceivers and RF amplifiers, damaging expensive power transistors and amplifier tubes.

High voltages, above 125 VAC, can burn out electric motors. Also, the increased peak voltages applied to filter capacitors, regulators, and transistors in power supplies, especially if the filter capacitors are already operating at or very near their rated working voltages can explode an electrolytic capacitor.

Such high voltages also increase the power dissipated as heat in the power supply transistors. This can cause extra heat at their junctions, causing them to fail, and thus applying a much higher unregulated DC output voltage to your station equipment. This can cause expensive damage.

How It Works

Fig. 1 is the circuit diagram. AC voltage applied through the line cord is half-wave rectified by Dl and applied to zener diode D2, which greatly reduces the peak voltage. Capacitor C1 acts as a poor filter and the partially filtered pulsating DC voltage is applied to meter Ml through meter multiplier trimpot R1. When calibrated, the AC line voltage is continually indicated on M1.

The value of C1 controls the voltage end limits. If you use a different meter, or wish a different voltage range, try different 150-volt capacitors in place of C1. Be sure C1 has at least a 150-volt rating. Its type is immaterial.

Construction and Calibration

The meter should be mounted in an enclosure to prevent any accidental contact with the AC voltage, which can be lethal. A plastic or metal box can be used. The few components can be mounted on a terminal strip. R1 is best attached to either the rear of the meter case or the interior of the enclosure, using epoxy, superglue or hot glue.

Look at your meter scale. With luck there will be four main divisions. If not, carefully take the meter apart and divide the meter scale into four equal, 10-volt divisions, using a fine tip felt pen. Mark these points 90, 100, 110, 120, 130. Reassemble the meter and mount it in its enclosure.

If you are unfamiliar with disassembling meters, please see my article, "Use Those Surplus Meters," *73 Amateur Radio Today,* January 1992, page 42. If you can't locate a copy locally, the publisher can supply back issues or article photocopies.

With your meter scale properly calibrated and all parts mounted in the enclosure, adjust R1 to maximum resistance. Using an accurate AC meter—a digital multimeter is preferred for accuracy, but a V-O-M can be used—measure the AC voltage at the nearest outlet, and note this value.

Plug in the Line Voltage Monitor. Being very careful not to touch any points carrying voltage, adjust R1 so the meter indicates the same voltage you measured previously. This completes calibration.

Operation is automatic. When this instrument is plugged into a live 117 VAC outlet it will continually monitor the level of voltage supplied by the power company.

Notes

Be sure the meter you use has a moving coil (D'Arsonval) movement. Do not use an iron vane meter. If you can't tell the difference at a glance, a good rule of thumb is: If it looks expensive, it probably is a D'Arsonval meter. If it is round or square and has a cheap-looking black painted metal case held together with bent metal tabs, it is probably an iron vane meter.

There are similar-looking line voltage meters commercially available costing

about $20. Some of these appear to use an iron vane meter. You can build a better monitor for a lot less money.

A major disadvantage of using an iron vane meter to which a voltage is applied continuously is that they lose accuracy as the movement becomes magnetized. You'll find that, if you unplug one after a year in use, the needle will not return to the left end of the scale. Instead, it will indicate some level of voltage even though none is being applied.

An excellent and inexpensive source of surplus name-brand meters with D'Arsonval movements is Fair Radio Sales, Box 1105, Lima, OH 45802. A selection of five meters (their choice, not yours), Catalog No. 47-84, costs $10. Mostly basic 0-1-mA movements will be in each selection. Usually there will be one, possibly two meters with 100-µA movements. Some may have internal shunts, multiplier resistors, or rectifiers, but these are easy to eliminate, leaving you with the desired basic meter movement. This gets you your meter for only $2, and you still have four more nice meters for future projects! 73

Parts List

C1	0.01-µF 150-volt capacitor,
D1	1N4007 rectifier diode
D2	1N4764A zener diode
M1	500-µA meter
R1	50-kΩ trimpot

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QRX–Canada Adopts IARP

Continued from page 8

President Farrell Hopwood VE7RD, and IARU Region 2 Vice President Tom Atkins VE3CDM. *TNX Amateur Radio Newsline*

Austrian Licensed

The Republic of Austria will celebrate its 1000-year anniversary in 1996 and Austrian hams will be a part of the celebration. This with the government authorizing special call sign prefixes for radio amateurs.

At the request of the Austrian Amateur Radio Society, communication authorities will permit Austrian amateurs to use the prefix OEM for the entire year. Use of the prefixes will be voluntary and the national society will sponsor two on-the-air operating awards in conjunction with their use. *TNX Amateur Radio Newsline*

Instructor Of The Year

Nominations are open for ARRL Instructor of the Year awards, the ARRL Herb S. Brier Award, the ARRL Professional Educator of the Year, and the ARRL Professional Instructor of the Year. Send nominations to your league Section Manager by January 31, 1996. *TNX Amateur Radio Newsline*

Cuban VHF Group Activities

In DX, the Cuban VHF Group is planning some activities to say goodbye to the "old" 1995 and will activate some "new" grids around the country.

From November 22th to the 26th, the group will operate an IOTA DXpedition to "Cayo Jutia," in Grid NA93. This is a little key 2 miles away from the north coast of Cuba's most western province, Pinar del Rio. Operators will be from Italy, Spain, Portugal, France, Mexico, and Cuba.

Operation is planned for 6 meters, 2 meters, and 1,296 Mhz. Other bands will be added if gear becomes available for 220 Mhz and 70 cm. *TNX Amateur Radio Newsline*

Tropo DX

Ken Rameriz KP3XS in Puerto Rico says that the best Tropo event he has seen in a long time occurred the evening of October 30th and was still present at 1 AM EST on Tuesday the 31st. Ken says, via the Internet's VHF Reflector, that he took to the airwaves at 8:30 PM EST and found the band open to Florida. He then proceeded to work every Florida grid down to the Keys. The only grid missed was EL86.

Ken says that he kept hoping one of the Cubans would get on but no luck. He did hear one of the Florida stations work KD4UPF in FM18 and quickly swung the beams North East where his first contact was KM1X in Rhode Island! Ken then went on to work 90 stations in the next 4 hours including WZ2O all the way to 1.2 GHZ!

Talk about a night of unbelievable tropo DX. *TNX Amateur Radio Newsline*

DX S92po

Meantime on the high frequency bands, look for Principie Island on the air from November 21st to December 6th. A group of French operators will sign S92P on all bands on CW, SSB, and RTTY. They will also be active in the CQ World Wide DX CW Contest. QSL via F6KEQ. *TNX Amateur Radio Newsline*

Martian Trivia

A bit of ham radio television trivia via packet from Tim Ertl KE3HT. And this is really going to take you back a few years.

How many of you remember the 1960s TV series, *The Munsters?* No, not the recent movie seen on Fox but the actual black and white TV show that featured Yvonne De Carlo as Lilly and Fred Gwenne as Herman Munster.

Well, Tim says one episode had a ham radio connection. He describes the plot as Herman playing ham radio operator using the call sign W6XRL/4, calling CQ. Then, while tuning around he bumps in to a couple of kids playing as Martians and as usual, things get out of control.

So Herman enlists the help of Grandpa Munster played by Al Lewis. Grandpa has a Radio Direction finder of sorts. Well it's really a transistorized divining rod that they use to find the Martians who are nothing more than some neighborhood kids.

KE3HT adds that it is obvious that the episode was done in fun, but he will bet one of the shows writers was a ham. *TNX Amateur Radio Newsline* 73

Manufacturers, we would like to review your products and report on them in 73. Please contact Ron at 800-274-7373 for more details.

Letters

Continued from page 6

my license. In 1987, I re-tested and quickly acquired my General License again. Late in 1994, I passed the Advanced Class upgrade, and in August 1995 I upgraded to Extra Class. I have had to renew my high school memory of trigonometry, as well as learn how to use a scientific calculator. My main talent is sewing, not electronics, but I passed the test, three months short of being eligible for Medicare. And I understand that keeping the mind active wards off Alzheimer's disease and other maladies. I am very appreciative of the ham community, which has kept the bands active throughout the years in order that those of us who have been less active still have frequencies on which to operate. That means the old-timers. They probably have more stick-to-it-iveness than some of the newcomers. If they have not become bitter through the years, they have more manners than some of the younger generation. And manners speak well for amateur radio. And, off of that subject: May I suggest/request that it would be easier to respond to "Feedback" if the back side of the listing were an ad, rather than an article or printed circuit diagram?

Noted . . . Wayne 73

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

January is seldom a good month for DX—or weather for that matter—and this month is no exception, so get ready for the bad news first.

There may be some very severe geo-physical conditions around the 15th or 16th and the 25th and 26th...give or take a day or two. Be prepared! The *best* days are likely to occur in the first, second, and last weeks of the month, while all else is trending.

However, the days are getting longer and you can expect the higher HF bands will be staying open longer. 80 and 160 meters will still provide excellent DX on the *best* days, and 40, 30, and 20 will do the same.

10–12 Meters

An occasional F2 opening toward the tropics during daylight hours...but, as is usual during sunspot minima, you can't expect much winter activity. Listen and call on the Good (G) or Very Good (VG) days.

15–17 Meters

Short-skip and some DX openings during daylight hours on Good (G) and Very Good (VG) days, particularly during afternoon hours. The band closes early, however.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA	20/40[1]					20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R.	40		40	40				20	20			

WESTERN UNITED STATES TO:

ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*						20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

[1]Check next higher band
*Bp-Meters possible on good days only

20 Meters

Fair to good DX during daylight hours, peaking shortly after sunrise for an hour or so, and again in the early afternoon; and closing at, or shortly after, sunset. Short-skip up to 2,500 miles or so during daylight hours. Again, listen on the Good and Very Good days. Check WWV at 18 minutes after any hour.

30 Meters

A strange and unpredictable band! Sometimes like 40 and other times like 20. Your best bet for DX is late afternoon and early evening hours. Short-skip during daylight hours will prevail.

40 Meters

DX to Europe and Africa during late afternoon and toward South America after sunset. After midnight, listen for Asia and the Pacific. Short-skip during days and longer skip after dark.

80 Meters

This should be your best DX band during hours of darkness, peaking around midnight and just before dawn. Short-skip in daytime and longer skip after dark.

160 Meters

Here's another wintertime DX band. Open after sunset, and peaking to the *east* around midnight, and toward the west and Pacific areas near dawn. Band closes during daylight hours due to high absorption of these lower HF frequencies.

Please let me know how these forecasts are working for you. By the way, keep your fingers crossed because 1996 may spell the sunspot minimum of Cycle 22. We can hope, can't we? 73, Jim "XU" 73

JANUARY 1996

SUN	MON	TUE	WED	THU	FRI	SAT
	1 F	2 F-G	3 G-F	4 F	5 F	6 F-G
7 G	8 G	9 G	10 G-F	11 F-P	12 P	13 P
14 VP	15 VP	16 P	17 P-F	18 F	19 F-P	20 F-P
21 F-P	22 F-P	23 F-P	24 P	25 P	26 P	27 P-F
28 F-G	29 F-G	30 G	31 G			

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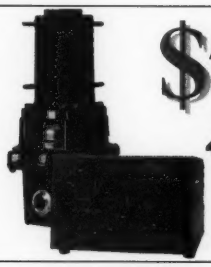

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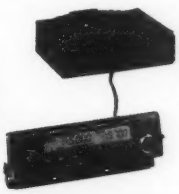

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Best Dual-Banders on Wheels

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TM-733A

FM DUAL BANDER

ISO 9002 Meets ISO Manufacturing Quality Standards

144MHz/440MHz Dual-Band Operation

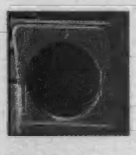
Kenwood's TM-733A is a versatile FM dual-bander with sophistication and power (144MHz; 50W/ 440MHz; 35W) for high performance mobile communications. As well as receiving simultaneously on VHF and UHF bands, it can receive two frequencies on the same band.

Six-In-One Programmable Memory

Six entire operating profiles—including everything from the frequency range to the dimmer level can be stored in the programmable memory for recall at the press of a button. It's like having six transceivers in one.

Data Connector for 1200/9600 bps Packet

Using the 6-pin mini DIN connector on the front panel, you can hook up a TNC to the TM-733A for either 1200 or 9600 bps packet communications.



1200/9600 bps packet compatible

* permits required for MARS and CAP use. Specifications guaranteed for Amateur bands only.

Theft-Deterrent Features

For the added safety, you can choose the quick-release detachable front panel kit (option). The transceiver unit can be concealed under a seat or in the trunk.

Theft Deterrent

Other Features

■ 72 multi-function memory channels ■ AIP (Advanced Intercept Point ■ Built-in DTSS with page ■ Cross-band repeater ■ Wireless clone function ■ Wireless remote function ■ Auto simplex checker ■ Built-in CTCSS encoder & optional TSU-8 decoder ■ Key function display ■ Modifiable for MARS/CAP*

144MHz/440MHz & 144MHz/220MHz Operation

The TM-742A (144MHz; 50W/440MHz; 35W) and TM-642A (144MHz; 50W/220MHz; 25W) dual-band mobile transceivers can be converted into tri-banders with the addition of an optional FM band unit: 28MHz (50W), 50MHz (50W), 220MHz (25W; TM-742A only), 440MHz (35W; TM-642A only), or 1200MHz (10W). The transceiver can display and even receive three bands simultaneously.

101 Memory Channels

For each band, there are 100 memory channels plus 1 call channel. Each channel can store transmit and receive frequencies independently or odd split repeaters.

TM-742A

TM-642A

Separate Control & Display Units

The display and controls can be mounted separatelyon either side of the steering wheel, for example — while the main unit is concealed in the trunk.

TM-742A/642A

FM DUAL BANDER

ISO 9002 Meets ISO Manufacturing Quality System

Other Features

■ Built-in DTSS selective calling with page ■ Independent SQL & VOL controls for each band ■ Built-in CTCSS encoder & optional TSU-7 decoder ■ Wireless remote control function ■ High-visibility illuminated panel keys ■ Wide-band VHF/UHF receive coverage (including Air Band) ■ Date & time display, stopwatch, alarm, on/off timer ■ Cross-band repeater function ■ Modifiable for MARS/CAP*

*Permits required for MARS and CAP use. Specifications guaranteed for Amateur bands only. Kenwood follows a policy of continuous advancement in development. For this reason specifications may be changed without notice.

KENWOOD

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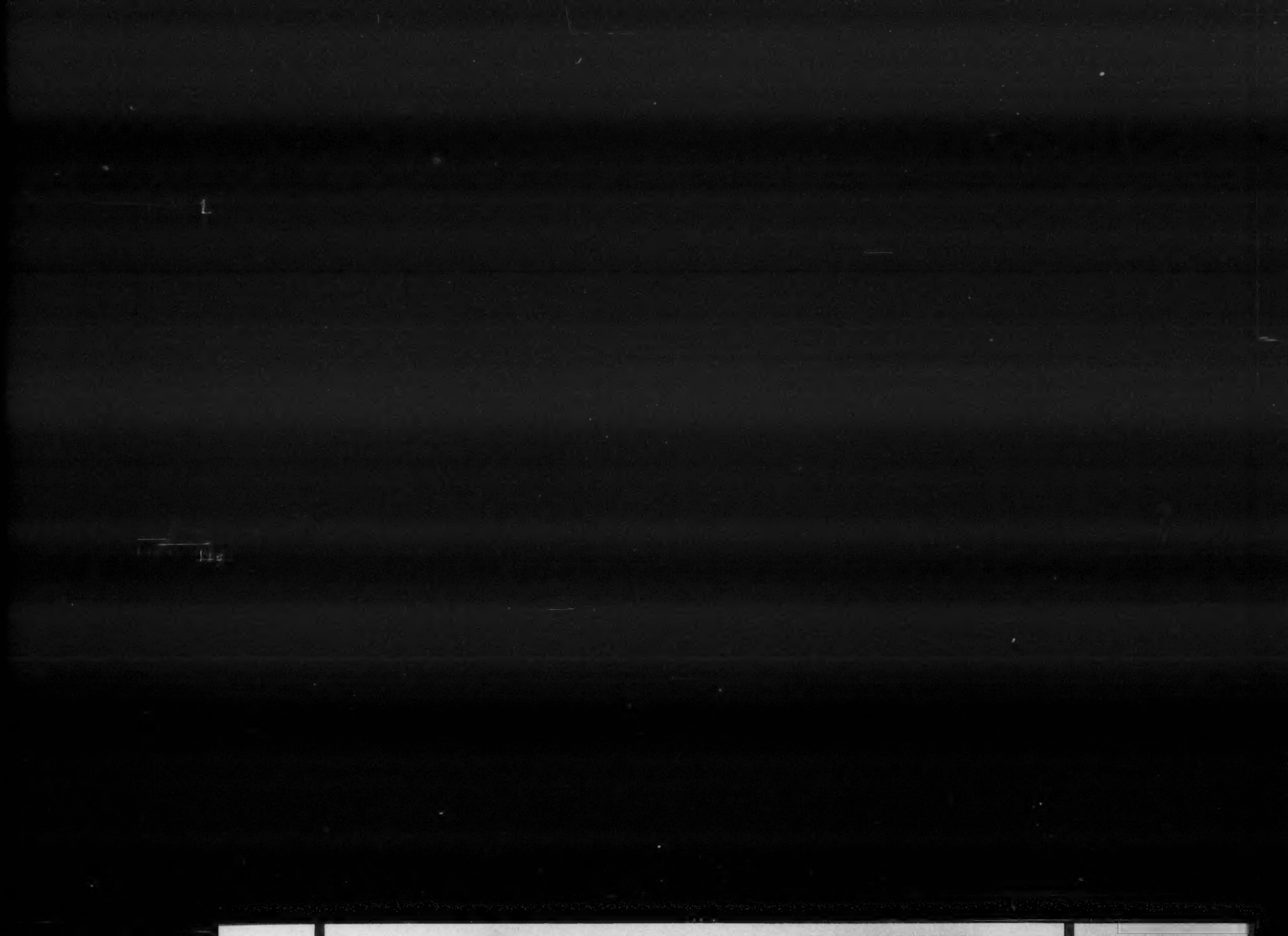
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